ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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ENGINEERING NEWS.

THE TOTAL GROSS AND NET RAILWAY EARNINGS of 128 railways for the month of April and of 126 roads for the first four months of the current year according to statistics collected by the *Financial Chronicle*, are as follows:

	April. 1890.	1889
Gross	$51,667,593	$45,151,175
Net	15,105,728	13,156,844
	Four Months.	
Gross	$194,217,925	$175,003,501
Net	55,878,208	50,150,460

CABLE POWER on the Third Avenue R. R. is now a certainty, the Court of Appeals having granted the company a mandamus compelling Commissioner GILROY to grant permits for its proposed cable road. This is the outcome of a litigation commencing in 1887, when the company tried to put in cable power under its charter, which permitted of the use of any motive power but steam. A mandamus granting the company power to open the streets was refused by the Commissioners of Public Works. The matter being carried to the courts, it was held that steam at the terminus for operating the cables was steam on the road in the meaning of the law. Application was then made to the State Legislature, and a bill was passed permitting any company to change its motive power upon receiving the consent of the State Railroad Commissioners. The Court of Appeals has held this bill to be constitutional, and has granted the mandamus for the opening of the street. The company will at once commence work on its line and have it completed in 6 months.

THE NEW YORK CENTRAL RAILROAD is renumbering all of its locomotives, of which it has over 800. Those from 1 to 249 will be switching engines, from 250 to 700 freight engines, and all above the latter number will be passenger engines. From the distribution of the numbers it is a simple deduction that the assumed proper proportion of switching engines to actual hauling engines is as 250 to 450, or 1 to 1.8, which is not far from the actual average proportion, and illustrates how many expenses there are in handling traffic which the public rarely thinks of.

THE WORST ACCIDENT OF THE WEEK occurred on the Baltimore & Ohio R. R., near Childs Station, Md. It was caused by the breaking of the left main rod of the locomotive, a part of which struck the fireman, killing him instantly. Two sleepers were thrown down a 50-foot bank, 15 of the passengers being injured, one of whom, Chief Engineer Ackenheil, of the Staten Island Rapid Transit R. R., died soon after. An accident nearly as bad occurred on the Reading R. R. at Tuckerton, Pa. It was due to an open switch, thrown by a brakeman on a gravel train. The locomotive and two cars of an express train were wrecked, killing two men and injuring two others. The cost of the wrecked rolling stock added to the sums the railway will have to pay to the families of the killed will exceed the cost of the interlocking signals and safety switches which should have been at this place.

BRIDGE ACCIDENTS are reported as follows: A flood at Atchison, Kan., carried away three railway bridges at 7th St., beside a number of small highway structures. A large bridge below Viele, Ia., on the Chicago, Burlington & Quincy Ry., has been washed out. The trestle of the Addison & Pennsylvania Ry. at Osceola, Pa., was carried away by a cloud burst. A foot bridge at Hoboken, N. J., gave way, throwing 40 persons into the water.

AN ELECTRO-MECHANICAL RAIL TESTING APPARATUS has been recently tried at Ermont, France. It is called a "schiscophone" and consists of a microphone and telephone combined with a mechanical striker and an induction anciometer. The instrument is claimed to be a reliable indicator of faults in the metal, and in the experiments made a defect was invariably found on breaking the rails at the places indicated as defective.

AN EIGHT-WHEEL ELECTRIC CAR is being tested on the Shawmut Ave. electric railway line at Boston, Mass. The car is 28 ft. long, 7 ft. 3 in. wide, and 7 ft. 9 in. high inside measurements. Its capacity is 46 passengers. The car is mounted on two four-wheeled trucks, and is provided with anti-friction bearings and centers, and with hand and vacuum brakes. The motor is a 15 horse power Thomson-Houston. In the test great difficulty was had in keeping the trolley in contact with the wire in rounding curves. No difficulty was found in rounding curves of 40 ft. radius, but considerable trouble was experienced in rounding a curve of 31 ft. radius, and it was found impossible to pass a curve with a 28-ft. radius. Improvements are to be made on the car, by which it is expected that all these difficulties will be avoided.

THE CONNECTICUT RIVER R. R. will soon try the experiment of lighting its locomotive headlights by electricity; storage batteries and 25 candle-power lamps will be used.

AN ELECTRIC LOCOMOTIVE HEADLIGHT was recently tested on the Columbus, Hocking Valley & Toledo R. R. The light in question is known as the Pyle and is of 50,000 candle power. The electricity is generated by a small motor placed on top of the boiler just back of the headlight and operated by steam power. The cost of the light complete is $350. The test proved very satisfactory, the light being strong enough to enable objects to be readily distinguished at the distance of a mile.

OMNIBUSES PROPELLED BY ELECTRICITY on the ordinary street surface are to be run in the city of London shortly from Charing Cross to King's Cross, carrying 26 passengers each. They will be driven by storage batteries, which will be charged at a station at King's Cross. Electric delivery vans or trucks for heavy traffic are also to be introduced in London shortly, and charging stations will probably be established at various convenient business centers. An electric butcher's cart is to be the pioneer in this direction, and will soon be given a trial. The era of the storage battery in this country has hardly begun as yet; but it seems alone certain to play an important part in the near future in the propulsion of minor vehicles both on land and water.

THE EDISON MAGNETIC ORE SEPARATING PROCESS is to be put to practical use at the old Ogden mine near Ogdenburg station, New York, on the New York, Susquehanna & Western R. R. The New Jersey & Pennsylvania Concentrating Co. has been organized for the purpose, and will, it is stated, equip the mine with the necessary machinery and commence work at once. Another ore separator, the Finney, is now being tested at Philadelphia, and proving to be of great promise.

ELECTRICITY IS USED FOR HEATING as well as lighting at a restaurant and café in Berlin. The electric light bulb is of delicate pink glass and throws out tinted rays favorable to ladies of delicate complexion. Coffee is made in glass jars, in which spiral platinum wires heat the water to boiling. From this coffee is made and distributed to the various tables on a small electric railway.

THE INTERNATIONAL ELECTRICAL EXHIBITION in Frankfurt-am-Main next year will cover about 15 acres. The directors aim at having every application of electricity exhibited. During the exhibition meetings of several societies will be held, among them the Society of Technical Electricians, the Hydraulic Engineers' Union and the German Physicists' Association.

THE REMOVAL OF A RAILWAY BRIDGE in the American fashion (with a difference) was lately made at Glasgow by William Arrol & Co. A bridge on the Glasgow & Southwestern Ry. was too small for the traffic to which it was subjected, so a larger one was built on trestles close to and parallel with it. Ways, similar to those in ship-yards, were then laid beneath both bridges, the old structure freed from both abutments and supported on these ways, and then moved off at the same time that the new bridge was placed in position. Traffic was delayed 17 hours by the operation. The two bridges together weighed 400 tons; span not reported. In our issues of Oct. 22, 1887, and Aug. 24, 1889, the moving of heavier bridges some 45 ft. in 15 to 17 minutes was illustrated.

A GREAT TUNNEL will shortly be started on the Colorado Midland Ry., 145 miles west of Colorado Springs. The surveys, plans, and specifications were made under the direction of Mr. B. H. BRYANT, the chief engineer of the line, and the contract has been awarded to Shanahan & Co., of Louisville, Ky. The tunnel will be 9,360 ft. long, and its cost is estimated at $1,000,000.

A LARGE DREDGING CONTRACT will be awarded by the government within a short time. Smith and Windmill Islands, the western part of Petty's Island, and the neighboring shoals in the D laware River, must be removed to a depth of 26 ft. below low water mark, necessitating about 17,000,000 cu. yds. of excavation. The cost is estimated at $3,500,000.

THE PAVING BRICK TESTS recently conducted by the Board of Public Works of Omaha, Neb., while not sufficiently exact to be of much importance, gave some interesting results. The bricks were tested for absorption, resistance to impact, and crushing strength. The following table gives the results obtained:

	% absorption.	Crushing strength sq. in.	% loss of weight.
Diamond Brick Co.	.008	12,286	.028
Beattie and Benning	.005	12,472	.030
Drury B. & T. Co.	.012	10,583	.125
Beatrice Paving & Building Brick Co.	.040	5,956	.134
Beatrice Sewer Pipe Co.	.077	6,220	.149
Joseph Deiss	.056	9,714	.140
Dawson, Ia.	.041	8,686	.147
Galesburg	.008	7,534	.179

THE LEARY TIMBER RAFT which recently left Newfoundland for New York, towed by two tugs was broken by the chafing of the connecting cables, and two of the 17 sections were lost in the Bay of Fundy. The raft was about 2,000 ft. long. It will be repaired at Rockland, Me.

THE MAXIM-NORDENFELDT GUN having been made the subject of some damaging reports, Mr. HUDSON MAXIM has written a letter ascribing these rumors to stock-jobbers solely. He says in his letter that the tests at Annapolis, in Russia, in Germany, and in Austria have been entirely successful. In some of the endurance tests in Austria 34,000 rounds were fired from a single barrel, 20,000 rounds of cartridges with steel-covered bullets being fired from a single barrel before the rifling was materially injured. One lock fired 40,000 rounds. Only one main spring broke in 200,000 rounds. In all these tests over 200,000 rounds were fired, and the whole 132 guns were accepted.

A NOVEL PUMP is in operation at Ocean Grove, N. J., for the purpose of pumping ocean water into Wesley Lake and making that body of water salt and more healthy. The pump is worked by the motion of the waves acting upon a hollow iron ellipsoid with a major diameter of 10 ft. and a minor diameter of 7 ft. The ellipsoid is fastened to the pier by iron arms and weighs, with the arms, about two tons. From its top a cable runs to a pulley and thence to a building on the shore which contains the pump proper, with which it is connected. The motion of the waves causes the ellipsoid to rise and fall, thus moving the cable back and forth and operating the pump. The pump is now lifting about 5,000 galls. of water a minute. The apparatus is the invention of Mr. N. O. BOND.

A BIG BLAST was recently discharged at Dorchester, Mass. The blast was arranged to blow out stone for a cellar from a ledge on Dorchester Ave. The ledge is of Roxbury pudding stone, and the contractor, JAMES A. KING, had drilled 19 holes 12 ft. deep and two holes 14 ft. deep, into which about 75 lbs. of dynamite had been placed. The surface of the ledge torn by the blast was about 20 × 50 ft. and the depth was about 15 ft., the stone being broken into fragments weighing from 100 lbs. to several tons each. A church which stood only 20 ft. from the blast was uninjured, with the exception of a small amount of glass broken in the basement windows.

ANOTHER ARCTIC EXPEDITION is to be undertaken providing the bill appropriating 200,000 kroner (about $56,000) asked by Dr. NANSEN, its projector, in aid of the expedition is passed by the Norwegian Storthing. Dr. NANSEN proposes to make the expedition in a vessel of his own invention built with very slanting sides to prevent its being crushed in the ice and just large enough to contain the necessary coal and provisions for a five years' trip. The grant in aid of the expedition is strongly recommended by the Mathematical Scientific Faculty of the University at Christiania.

A SITE FOR THE WORLD'S FAIR has been decided upon by the directors. The site chosen is what is known as the lake front site, and lies between Sixteenth and Monroe Sts. It has an area of 250 acres, and by the additional filling in of a strip 700 ft. wide 100 acres more can be obtained. Negotiations are now in progress with the Illinois Central R. R. Co., which owns a right of way 200 ft. wide along the lake shore, upon the satisfactory conclusion of which the commissioners will issue $5,000,000 of bonds and commence work.

AN EIGHTEEN STORY BUILDING to cost $2,000,000 is to be erected in Chicago for a Masonic Temple. The building is to be located on State St., between Randolph St. and Burton Pl. Burnham & Root are the architects. According to the plans the structure is to be 18 stories high with ground dimensions of 170 × 114 ft., and it will be constructed of steel with a facing of terra-cotta, stone or brick. The basement and a large part of the building will be given up to stores located around the rotunda which will occupy the center of the building and run to the extreme height of the roof. Eighteen large elevators will furnish access to the various floors.

MANUFACTURING TOWNS BUILT BY PRIVATE CAPITAL are becoming quite a common feature of our manufacturing States. Two such are about to be built in Pennsylvania; one by a Pullman-Westinghouse combination, which proposes to engage in car building, and the other by a syndicate of English capitalists from Oldham, England, a large cotton manufacturing town near Manchester, with cotton manufacturing as its business. This last town will be called Oldham, and elaborate preparations have been made for its construction and the establishment of its proposed industry. About 650 acres of land have been purchased for a site, waterworks, gas and electric light franchises have been procured, plans for 500 houses for workmen completed and several cotton mills, each of 30,000 spindles and 1,000 looms, and each to employ 600 hands, are to be built.

The Walls of the Wet Dock at the Port of Havre, France.

Without going into the detail set forth in *Le Genie Civil* for May 17, the account there given of the method of constructing this dock is very interesting, and we make the following abstract:

The Beliot basin is the ninth in number of the docks in the port of Havre. It is on property almost entirely reclaimed from the sea, and bounded on the south, or seaward side, by a masonry dike 3,320 ft. long and a boom, or breakwater, of framework 1,770 ft. long. There are two basins in a line, separated by a gate and an entrance gate from the *Bassin de l'Eure*. Each basin is 210 m. wide by 450 m. long, and the bank separating them 100 m. wide.

The main dike-wall is founded on the original shore on a béton platform about 5 ft. thick. The height of the wall is 29.5 ft. above the top of platform and its thickness varies from 9.8 to 19.7 ft.; surmounting this on the outer edge is a wall about 4 ft. thick and 3.3 ft. high, carrying a heavy granite coping, 20 ins. thick. Up to the height of about 23 ft. the wall is béton with ashlar tie walls 3.3 ft. apart; above 23 ft. the wall is all ashlar.

The entrance lock is 98.4 ft. wide and the sill of the lock is leveled off at such a depth as to secure 27.2 ft. of water on it at the lowest tides. This lock, founded on a soil made up of sand and pebbles mixed with clay, rests upon an inverted arch of beton, 174 ft. wide by 98 ft. long, covered with three courses of brick. The thickest part of the inverted arch is 14.76 ft. and the lower arch is 3.3 ft. thick.

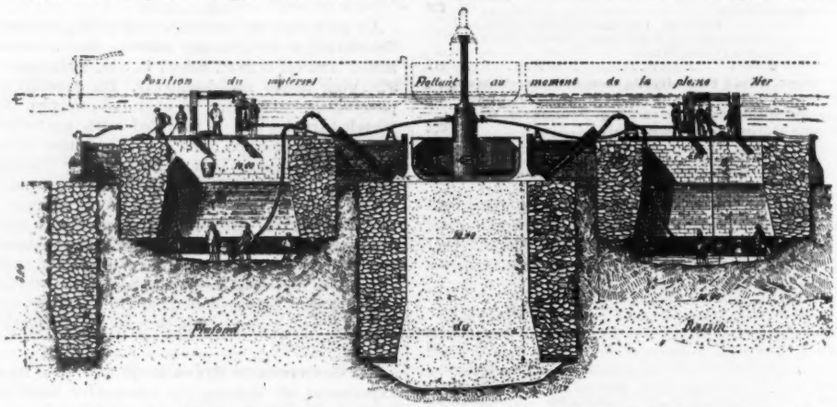


Fig. 1.—Plant for Sinking Masonry Blocks; Pumps with Horizontal Axes. Havre Wet Dock.

Passing to the construction of the dock, the bottom of which is at — 9.35 ft., the basin walls are vertical for 23.45 ft. and then continue with a slope of ⅓th to the granite coping, which is stopped at the level of 30 ft., or 3.3 ft. above the highest equinoxial tides. These wall were built either in the dry, by draining the pit, or by working between tides. Including the foundation, the walls are 39.36 ft. high, and their average thickness is .4 of the height. In the upper part of the walls is built a passage way for holding the conduits of water under pressure to be used in operating the various hydraulic engines.

The time at command and the conditions of the work did not permit the construction of a coffer-dam inclosing the entire dock area. The west dock had to be put into service with as little delay as possible, and the greater part of the work had to be built in the water, including the main dike and about two tiers of the masonry of the dock walls; after the dike was built and a temporary coffer-dam put in to connect it with the shore, the remaining work was done in the dry by dredging and pumping.

The main dike, 3,330 ft. long, was commenced at both ends simultaneously. The site of the work was completely exposed to the tides and was submerged at each high tide from 6.6 to 13.2 ft., and even touching 20 ft. in exceptional tides. Piles could not be economically driven except by machines worked by hand, and floating steam pile drivers were impracticable owing to the difficulty in keeping them in position, the loss of time in taking them away at low tide, and the fact that they could only work about 2½ hours in 24, or 63 hours per month, not counting bad weather.

The mortar and béton were mixed on shore and conveyed to the work at low tide by a submerged way. The administration charged with the execution of the work commenced by sinking a pump at each pit with two centrifugal pumps worked by telodynamic cable, operated by two 18 horse-power engines on shore. The results were unsatisfactory and it very frequently happened, during the earlier stages of the work, that the workmen would be compelled to place the béton under 1 to 2 ft. of water.

The administration then drained the pits by the aid of machines, descending to the beach and drawn back again with each tide. There were 30 of these pumps for the dike, and the motor force required to lift the water was the equivalent of 63 horse-power. Afterwards piles were driven and the excavation and coffer-damming and the placing of béton was proceeded with by ordinary methods, building the wall up in steps. Notwithstanding the fact that the work was frequently interrupted by storms, and at times partially destroyed, this 40,000 cu. m. of masonry was finished in 36 months.

The depth of the pits or trenches founding the walls of the dock proper was about 26 ft. The loss of time in emptying these at each tide, and the caving of material produced at each return of the tide, rendered impracticable the method adopted for the dike wall. The engineers, owing to these considerations, then determined to make the foundation in blocks of masonry of the width of the wall itself and sunk into the soil to the necessary depth. These blocks were then to be united by short arches supporting a continuous wall of masonry. These blocks were rectilinear in plan in the straight walls, and had a trapezoidal section, with a curved side, in the corners.

In dimensions, these blocks were 33 ft. long, 22.9 ft. wide and 26 ft. high, with a central well, leaving a shell of masonry 7.2 ft. thick above and 5.6 ft. below. Afterward the well was filled with béton and presented a total volume of 536 cu. m.

The sinking of the blocks was done in two operations; the first was to sink the blocks two at a time, leaving a space of 39.4 ft. between them; the second operation consisted in sinking blocks between these after the others were completed. This plan was adopted to avoid the disturbance of material, and the consequent shifting of the blocks in descending, that would have resulted from the simultaneous sinking of two blocks close together.

The blocks were started on a timber frame or grillage, 8 ins. thick, for which afterwards planks were substituted as sufficient to prevent the bottom blocks of stone from sinking into the soil. The total time consumed in founding and building one dock was 106 days, or 112 tides.

The construction of these blocks was rendered particularly difficult owing to the numerous obstacles in the way of getting material to them. As the outer dike wall was raised the water coming with each tide to the site of the wet dock deposited the mud held in suspension, and, as a consequence, after each tide the work already done was covered with a layer of mud. The soil of the old beach was equally covered with this soft mud, and would not carry the temporary tracks, and the workmen were confined to a single track established against the blocks. And, finally, the soil left between the blocks was continually being undermined and

washed away at high tide and the wells in the blocks filled with mud. Notwithstanding these serious difficulties, there were no accidents of moment.

In sinking the blocks, during the first stage of construction. Letestu hand-pumps were sufficient; but centrifugal pumps operated by Brotherhood motors were soon substituted for them, as shown in Fig. 1. This system answered as long as the lift of the pump did not exceed 23 ft.; but for the deeper foundations, touching 33 ft., the plan shown in Fig. 2 was adopted. In the latter case a centrifugal pump, with a vertical axis, was placed on a platform suspended in the well; the axis was prolonged to the top of the wall and there operated by a Brotherhood motor. This arrangement gave good results in sinking, but in filling the well with béton it was necessary to continually shorten the suction pipe, and when the pump itself was reached it was removed and the Letestu hand-pumps again brought into play.

The contractor, Mr. ADRIEN HALLIER, introduced a feature in the plant for which he has secured a patent. This consisted in making the entire plant movable, enabling it to follow without difficulty the total progression of the work of sinking and filling. A centrifugal pump, with a horizontal axis and direct action, was placed with its motor between the four guides of a framework suspended in the interior of the block well; these could be raised or lowered by the aid of a simple windlass. At the end of one tidal shift the pump was lifted to the top of the well, and on going to work descended again as the water lowered. In filling, the suction pipe was successively shortened, and the pump was only lifted as the masonry advanced. By this means the drainage of the well never required more than three-fourths of an hour at the commencement of work.

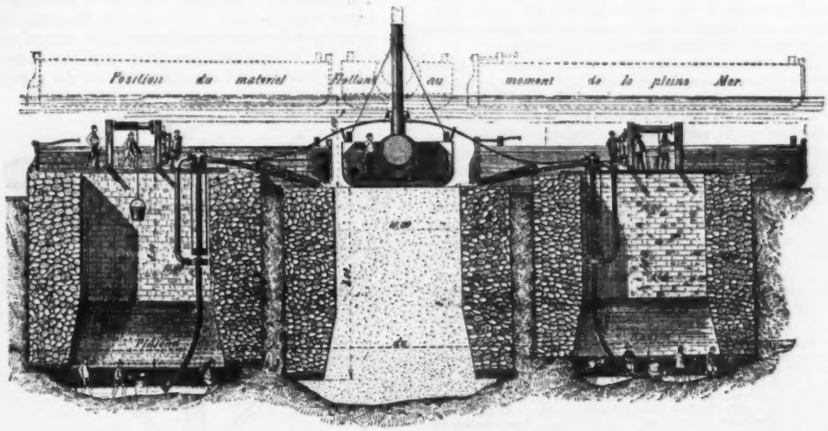


Fig. 2.—Pumps with Vertical Axes, for Deep Sinking of Masonry Blocks. Havre Wet Dock.

The material was hoisted in buckets by a steam-engine fed from the boilers of the drainage pumps, and was discharged into barges alongside. These barges were brought in empty at high tide behind the walls and allowed to ground, as shown. Four blocks were generally being sunk at one time; a barge placed between two blocks contained the steam-generator and fed the pumps and two hoisting engines; all of this material, including the two barges for carrying away the material, floated at high-tide, as shown in the figures.

In this manner 87 blocks were built, making a total length of 2,886 lin. ft. of dock wall. The blocks were almost always maintained in the vertical, and the deviation in alignment did not exceed 1.9 ft. These irregularities were adjusted by corbeling out in the upper parts of the wall. The final dredging out of the dock presented little of interest.

Compound Locomotives.

REPORT OF COMMITTEE OF THE 1890 CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

The slight experience America has had with the compound locomotive, although elsewhere there are between 600 and 700 in successful service, so contracts the possible field to be covered by a report on the subject assigned to us that we, of necessity, must go beyond the limits of this land and of this association for the major part of our facts, and in expressing opinions and conclusions are compelled to take for granted a fair acquaintance with its modern literature, giving the experimental results of trials carried on outside the American continent.

To commence with—and as a help in the direction of narrowing the province to be covered by this report—we would suggest for discussion the following questions, viz.:

1. Is increase of boiler pressure an essential element in the success of compounding?
2. What gains have followed compounding?
3. What are said to be its losses?
4. What, per engine, is the increased first cost of compounding?
5. Does the saving more than balance this cost?
6. What are American conditions for locomotive service, and can the compound locomotive meet them?
7. Is it an essential defect of the compound that it must be short of starting power?
8. Give a brief summary covering some details and peculiarities common to compounds.

1. Is compounding of any value without increase of boiler pressure?—This query is due to the repeated assertion that in compounding there was not, and could not be, an economy in steam consumption, unless the boiler pressure be decidedly increased, raised to 170 lbs., or even higher. The results of the experiments of Mr. T. URQUHART, Locomotive Superintendent G. & T. Ry. (Southeast Russia), contradict this statement. The trials cover a period of ten months, in the same class of service, with simple and compound engines practically of the same weight, and all with pressures of 135 lbs., and they show for the compounds a general average saving in fuel of 18%.

Apart from this solution of the vexed question of pressure, Mr. URQUHART'S experience is unusually interesting, because the experiments were carried out in cold weather, with oil fuel, which has a more uniform heating quality than soft coal; and the delivery of the fuel into the fire-box was almost automatic, thus practically getting rid of the "personal factor," for which it is always necessary to allow in comparing special and brief experiments.

Mr. C. SANDIFORD, of the N. W. Ry., Lahore, India, reports a 13½% economy with unaltered, but still lower, pressures, viz., 120 lbs., the saving being the same whether the steam was used in two or four cylinder (tandem) engines.

These results will not surprise those who are familiar with exactly parallel cases in other forms of steam engineering.

Do not misunderstand us to say that there are no economies in higher pressures. There are wide possibilities with high temperatures; and the many published figures, from recent trials, stoutly confirm our opinion. But under this leading heading, the committee wished to emphasize the fact that compounding, at ordinary working pressures, has its own value as an economizer of steam, without keeping hid the sister fact that higher pressures give an additional possibility. And it should not be forgotten that very high pressure steam has, so far, only been fully utilized by passage through more than one cylinder.

Higher pressures and very early valve cut-offs, for simple engines, have had a fair trial on many of our railroads; nevertheless, to-day initial cylinder pressures above 150 lbs. are rare; and we believe that when boiler pressures higher than 160 lbs. are retained, it is with the object of making the boiler a reservoir of power for starting and grade climbing, rather than with a confirmed faith that very early cut-offs lower the fuel bill.

The Saxony Ry. report increasing their boiler pressures for simple engines from 8½ to 12 atmospheres (say from 120 to 175 lbs.), without resultant economy; whereas 212 lbs. has not proved too high for convenience or economy in the compound practice of the P., L. & M. Ry. (France).

2. What gains have followed compounding?—(*a*) It has achieved a saving in the fuel burnt averaging 18% at reasonable boiler pressures, with encouraging possibilities of further improvement in pressure and in fuel and water economy. (*b*) It has lessened the amount of water (dead weight) to be hauled, so that (*c*) the tender and its load are materially reduced in weight. (*d*) It has increased the possibilities of speed far beyond 60 miles per hour, without unduly straining the motion, frames, axles or axle boxes of the engine. (*e*) It has increased the haulage power at full speed, or, in other words, has increased the continuous H. P. developed per given weight of engine and boiler. (*f*) In some classes it has increased the starting power. (*g*) It has materially lessened the slide valve friction per H. P. developed. (*h*) It has equalized or distributed the turning force on the crank pin, over a longer portion of its path, which of course tends to lengthen the repair life of the engine. (*i*) In the two-cylinder type it has decreased the oil consumption, and has even done so in the Wolfe four-cylinder engine. (*j*) Its smoother and steadier draught on the fire is favorable to the combustion of all kinds of soft coal; and the sparks thrown being smaller and less in number, it lessens the risk to property from destruction by fire. (*k*) These advantages and economies are gained without having to *improve* the man handling the engine, less being left to his discretion (or careless indifference) than in the simple engine. (*l*) Valve motion, of every locomotive type, can be used in its best working and most effective position. (*m*) A wider elasticity in locomotive design is permitted; as, if desired, side rods can be dispensed with, or articulated engines of 100 tons weight, with independent trucks, used for sharp curves on mountain service, as suggested by Mallet and Brunner. One such engine of 80 long tons is now under construction.

3. What losses are said to have followed compounding?—(*a*) In some particular types, as actually proportioned, a loss in starting power of from 1% to 20%. However, loss of power in starting cannot be said to be a defect in the principle of compounding. (*b*) An increase in the number of parts. They are few and plain in the two-cylinder engine, entailing little outlay at first cost or in repair. (*c*) A possible, but this committee thinks not probable, increase in the cost of repairs to the boiler, per pound of fuel burnt, if higher pressures are used. Positive information on this point is difficult to obtain. (*d*) An increased cost of repairs to the engine per mile run. This item is not yet large enough to be measurable, after three years' continuous service in the plainer forms of the two-cylinder compounds. (*e*) A larger percentage of failures on the road due to greater complication and size of parts. (*f*) Increased reciprocating weights on one side, either not balanced, and so increasing the deflection of the engine, or, if approximately balanced, the balance weight doing injury to the roadbed, etc. The two last sections seem to be pure suppositions, which, after search, we find no evidence to sustain. (*g*) Want of variability or adaptability to wide extremes in speed, and to amount of work to be performed; so that a large compound does not work as cheaply when hauling light loads, or running without load, as a simple engine does.

It is not proved that a compound, working properly throttled, that is, with steam wire-drawn, may not have actually, as she theoretically has, a wide and economical adaptability. So that if the compound, like any other motor, be not as economical when exerting low power as when exerting full power, it probably will use less steam than the simple engine of same weight, working under similar conditions of light haulage duty.

However, the one thing certain about "American conditions" is that no large portion of our motive power does run lightly loaded, and until we have a wider experimental experience, it is not recommended that all locomotives, doing branch and local light service, be built compound.

4. What is the increased first cost per engine? M. V. BORRIES has published figures giving cost. In speaking of his own design of engine, he says:

> They can be built 2% to 5% cheaper than single engines of the same power—not of the same maximum tractive force; because this power depends upon the boiler, which might be 10% to 15% smaller for the compound engine. If the same boiler is kept, as is commonly the case, the compound engine would be some 2% or 3% heavier and 4% or 5% more costly than a simple one; but, with properly dimensioned cylinders, 10% to 14% more powerful than the latter. For equal work, the compound engine would always be the cheaper engine.

Mr. E. WORTHINGTON says:

> The intercepting valve and copper pipes forming the receiver, and the patterns for two different sizes of cylinders, are the chief items which raise the cost of a two-cylindered compound locomotive; while engines with three or more cylinders have additional parts, which considerably increase their cost. In engines with four cylinders, the tandem system is cheaper than the receiver system. Tandem cylinders are, however, objectionable, because the pistons are difficult to examine; but the receiver system is ready of access, and affords an opportunity of heating the intermediate steam by circulating it among the waste gases of the smoke box; and, by isolating the high-pressure and low-pressure cylinders, an advantageous difference of temperature is maintained between them.
>
> The cost of constructing a number of two-cylindered locomotives does not greatly exceed that of the same number of ordinary engines. The cost of three-cylinder loco-

motives may exceed that of simple engines by $1,000 to $1,250 each.

The cost of changing simple to two-cylinder engines need not exceed $250 to $300 each, if the expense of drawings, patterns, and templets be divided over a series of engines. The additional cost of building a two-cylinder engine, with receiver, etc., as used by the Michigan Central Ry., or the ingenious form of four-cylinder engine, as used by the Baltimore & Ohio Ry., need be little, if anything, over $200 (excluding royalties), or say from 2% to 2½% increase on the cost of a simple engine.

5. Does the saving more than balance the increased first cost?—If, for convenience, the fuel saving be taken at 17%., or one-sixth, and the gross consumption at 900 tons per year, with coal at $1.50 per ton, the decrease in the annual fuel bill is but $225. Certainly not a wide margin to cover contingencies. If, however, at first only the more powerful engines are compounded, whose consumption averages 1,200 tons per year, and coal, as is common, costs on tender $3 per ton, the saving on fuel is $600, or two cents per mile on a mileage of 30,000 per annum. As this amount would cover not only reasonable interest on first cost, but also allow for about 33 per cent. increase in total expenditure for motive power, repairs and renewals, the saving is certainly enough to permit a possible, but we think not a probable, largely increased cost of engine repairs, and yet have a margin of saving on the final balance sheet to the credit of the compound.

6. What are "American conditions" for locomotive service? Can the compound engine meet them?—We have given this section a large amount of attention, because it has so often been said that the compound must, to be successful on this continent, be adapted to suit American conditions, and your committee naturally were desirous of fully understanding these conditions. They have not been specified by those making the assertion; and we must reluctantly confess to having failed to identify, much less define them, so that after a long, unsatisfactory chase they appear to us to be somewhat mythical. If any member can, and will, specify them, he will confer a favor, at least upon the committee, if not upon the Association.

If an American condition be large starting power, then the Mallet two-cylinder and all four-cylinder engines easily have cylinder power in excess of their adhesive weight. If American conditions be ability to do satisfactory work on a second-rate or third-rate roadbed, or simplicity of construction, or easy accessibility of parts, then these conditions are met by any two-cylinder engine, or by the B. & O. R.R. four-cylinder engine.

Apparently neither climate nor men are factors in this equation, as compounds are a success in the hands of ordinary enginemen in partially civilized countries; and in hot climates, as well as in Russia, under conditions of low temperature and snow as trying as those ordinarily met with inside of 51°, the present northern limit of our railway belt.

7. Is it an essential defect of compound locomotives that they must be short of starting power?—Certainly not! The starting power of the Mallet type is at least equal to that of a simple engine of the same weight, and its cylinder power can easily be made to exceed it, by allowing more than half boiler pressure in the large cylinder for the first few revolutions. In the Von Borries, Worsdell, Pitkin and other two-cylinder types, and the Lepage three-cylinder engine, their starting power (as Professor Woods has graphically illustrated), at 170 lbs., may be greater than that of a simple engine at 150 lbs., having cylinders of the same size as the high pressure, *during the first half revolution*, but that after this power (at low speed) of the compound diminishes to 80% or 85% of that of the simple engine. This conclusion is modified and improved by the knowledge that all two-cylinder engines originally designed as compounds have, or should have, their small cylinder larger than the cylinder of the simple engine of corresponding weight or duty.

It is possible, with the Lindner or equivalent form of starting valve—and a painstaking engineman—to get about 90% of the starting power of a corresponding simple engine. The Webb type of three-cylinder engine (except with the low-pressure crank dead on center), has cylinder power enough to slip both pairs of wheels, and no higher starting power is desirable. What may be called the opposite form of three-cylinder engine (the Sauvage type), with cylinders of approximately the same diameter as used on the Northern Ry. of France, has ample starting power, because the full boiler pressure is admitted direct to the two low-pressure cylinders. In fact, if desired, the locomotive can be continuously so worked, viz., as a simple engine. Tandem and other forms of four-cylinder engines are not wanting in starting power. The B. & O. R. R. engine in starting, with a gear as simple as the water-tap gear, puts the small piston practically into equilibrium, and thus admits high-pressure steam to the large cylinder.

A mean effective pressure of 90 lbs. in a simple 18 × 24 in. engine will start a train of 13 coaches on a level in a lively fashion, and a compound can easily give the equivalent of that total pressure without being overcylindered.

Going back to the two-cylinder style of engine, with automatic intercepting valve and limited size of cylinder, would it seem as if all of them were capable of getting into motion the load they were designed to haul at full speed, so that their limitations are that they do not get away quite as smartly, quite as noisily, or with the same tearing effort on fire and fire-box as do certain simple engines that waste both fuel and steam in starting. The comparative difference in time or distance required by this class of compound to attain maximum speed has not yet been shown by experiment, but is probably less than is generally supposed.

Mr. Urquhart, desiring to settle the question of the tractive power of simple engines altered to compound, with one cylinder unchanged and with boiler pressure unchanged, carried out tests, using both indicator and dynamometer; and he reports that at a speed of 10 miles per hour the compound passenger engine suffered the following diminution, viz: in first notch, 42%; in second notch, 28%; in third notch, 17%; in fourth notch, 7%, and in fifth notch, or full gear, 5%. And a similar test of the freight compound showed, in the first notch, 27% loss; in the second notch, 17%; in the third notch, 10%, and in the fourth notch, or full gear, 5%. He goes on to say that, for all practical purposes, in full gear a 5% difference, at this speed, may be neglected.

8. General.—A recent press notice credits Mr. Webb with an attempt to reduce first cost, by throwing away the valve gear for the low-pressure cylinder, and using in its place a single loose reversing eccentric—in other words, with an attempt to use an invariable cut-off for the large cylinder. And such practice is not unreasonable, if it from the first be acknowledged that the compound is designed for doing a maximum specific duty with high economy, and, therefore, the valve gear cannot be, and is not, arranged for a wide variability of service.

This intention in design most clearly marks all those engines using but one valve, or one valve stem, to distribute the steam to both high and low pressure cylinders; such, for instance, as the Vauclain piston valve, the Wolfe hollow D valve, and the Dunbar single valve stem. In the two first mentioned most ingenious valves, the release of the high-pressure cylinder must be at the same moment as the admission to the low pressure, or it is no actual release; and the cut-off in the low-pressure cylinder marks the exact point when compression in the high pressure cylinder commences, there being no appreciable "receiver" capacity in the valves themselves, large as the passages through them have to be. There is, then, it is clear, little elasticity of adjustment in such valves and gears. The cut-off being early in the small cylinder it must be early in the large, and as a result the compression in the small cylinder is enormous. Thus the conclusion is again brought home to us that the control of the compound, when small horse power is to be developed, must be chiefly through the throttle wire-drawing the steam, and thus reducing the initial pressure.

Putting emphasis on this truth will not frighten those who are familiar with the fact that wire-drawing is common today with our best enginemen. And it may here be noted that the *imperative necessity* for this so-called "crude practice" is the full explanation for the slight use in modern locomotives of screw and other finely divided reversing gears. This statement opens up the whole matter of cylinder condensation, but it is too large a matter to be properly treated in this report.

However, such modern experimenters as Westinghouse, Kennedy, etc., prove that wire-drawing the admission into cylinders of large surface and small volume is more economical than valve cut-offs at less than 50% of the stroke.

There are some constructive details and peculiarities about compounds that may deserve special mention. For instance, it is judicious to put safety or relief valves on the low-pressure chest or cylinder, but they should be so located or guarded that, in case they came into action, they should not smother the engineman with steam and obscure his vision. All types do not require water-taps on both cylinders, but most receivers should be so drained. If an intercepting valve is used a reducing valve is not required, and if an intercepting valve is not used there must be a valve to give independent exhaust direct to the atmosphere from the high-pressure cylinder. The weight of evidence so far is in favor of the use of an intermediate receiver. Such a device effectually isolates the cylinders, so that each retains its distinctive temperature. The general practice of drying the intermediate steam by putting the receiver in the smoke-box has much to recommend it. Copper pipes set close to the curve of the smoke-box are not cumbersome, or much in the way, and if it be desired that the feed-water also be heated in the smoke-box the large receiver pipes need not interfere with the details of such an arrangement. Receiver capacity cannot, under our limiting conditions, be too large. It should never be less than 1½ times the volume of the high-pressure cylinder, and two or more volumes are desirable, because, with a liberal receiver, the steam supply to the low-pressure cylinder is more uniform in pressure and amount, the reheating or drying of the steam is more thoroughly done, and "the drop" in pressure between high-pressure final and low-pressure initial is less detrimental to steam economy.

If one side of a compound should break down, the other side can be run as a single cylinder engine, if the failure is not due to a total collapse of the cylinder on the side to be blocked. And in a tandem, as in a simple engine, the failure on one side may be a total collapse, without its interfering with the use of the other side as a single engine.

J. Davis Barnett,
John Player,
H. D. Garrett,
F. W. Dean. } Committee.

APPENDIX.

Size of cylinders for compound. M. von Borries' rule for the large cylinder is:

$$d^2 = \frac{2ZD}{pA}$$

in which

d = diameter of the low-pressure cylinder in inches, D = diameter of the driving wheel in inches, p = mean effective steam pressure per sq. in. (after deducting internal machine friction), A = stroke of piston in inches.

Z = tractive force required, usually 0.14 to 0.16 of the adhesion (say 0.15, it being understood that allowance is made for the external engine friction, taken as equal to the whole friction of the cars).

The value of p depends upon the relative volumes of the two cylinders (or, if their strokes are equal upon their comparative cross-sections), and from experience and indicator experiments may be taken as follows:

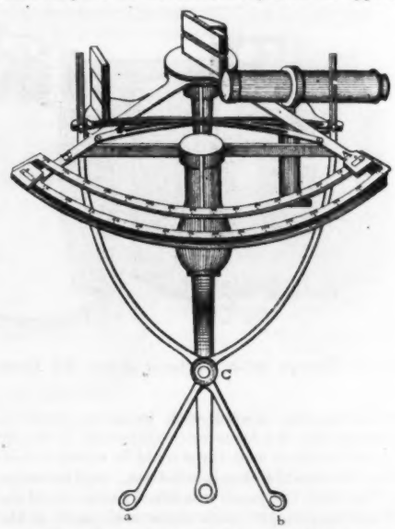
Class of engine.	Relative section or ratio of cylinders.	p in per cent. of boiler pressure. Per cent.	p for a boiler pressure of 176 lbs. Lbs.
Large tender engine.....	1:2 or 1:2.05	42	74
Tank engines.....	1:2.15 or 1:2.2	40	71

For engines working long grades Z should = 0.16. And if the steam pressure is increased from 15 to 30 lbs., and the cut-off is to be 0.3 to 0.4 of the stroke in the small cylinder, the large cylinder may be 1.5 that of the cylinders of the ordinary simple locomotive for the same service. These figures are from M. V. Borries' publication in 1888, and, as Prof. Woods points out, are an increase in cylinder volume of about 7 per cent. on those given in 1886; whereas Mr. E. Worthington, in 1889, quotes M. V. Borries as recommending that the small cylinder be made the same size as one of the simple engine cylinders, and that the large cylinder should be twice the capacity of the small; boiler pressure being increased as before.

A Double Sextant for Hydrographic Surveys.

The present method of locating soundings taken in rivers and harbors by sextant angles is unquestionably the most convenient, if not the most accurate, of any now in use; but like many other good things, it has its faults.

In making hydrographic surveys of rivers when frequent cross sections are required, sounding flags or signals, which are usually pieces of cotton cloth 12 × 18 ins., or of sizes depending upon the distance which they are to be seen, are placed on opposite



Double Sextant for Hydrographic Surveys.

banks of the river at the ends of the sections. These signals are located by the shore line parties or topographers, usually working in connection with a hydrographic survey, and are used by the hydrographer in locating his soundings.

On rivers having a strong current, such as the Mississippi, a sounding party consists of two sextant observers, one recorder, one leadsman and six boatmen. A boat 22 ft. long, of "cutter" build, is generally used. The boat is kept on line at a uniform speed, between the signals on opposite banks, as nearly as possible; the leadsmen taking soundings at regular intervals of time as called by the recorder; while the sextant observers locate a sufficient number of these soundings by reading angles between any three of the signals in sight which will make the best "cut-off," to determine the exact direction of the line sounded.

The inaccuracy of this method lies in the difficulty of measuring the two angles simultaneously. If both angles are not taken at the same instant the swift current, combined with the efforts of the oarsmen, will carry the boat beyond the point where the sounding was taken before the last observer had measured his angle. Another difficulty is frequently caused by confusing the numbers of the signals, or by one of the three signals necessary for a location not being used by both observers.

By using the double sextant illustrated only *one* observer is necessary. Both angles are read simultaneously; and of the three signals necessary for a location, the one common to both angles will be used, thus gaining three quite important points, *i. e.*, accuracy, economy and more room in the stern of the

boat. The sextant was designed by Mr. G. W. WOOD, Asst. Engr., and has been adopted by the Mississippi River Commissioners for work in surveys.

The method of using the double sextant is as follows: The arm *A* is moved from right to left (the limb for this arm being graduated in that direction) by pressing the lever *A* towards the center. The result of this motion is the same as with the ordinary sextant, *i. e.*, the reflected signal is carried to the left until it is directly under the signal which it is desired to read to.

Leaving the arm *A* in this position, the telescope is next directed to the signal on the left, and by pressing the lever *b* toward the center, the arm *B* is moved from left to right (the limb for this arm is graduated from left to right), until the reflected left-hand signal is carried directly over the middle signal. It will now be found that the three signals, two of which are reflected, are nearly in the same vertical plane, one above the other, the reflected signals being the upper and lower ones.

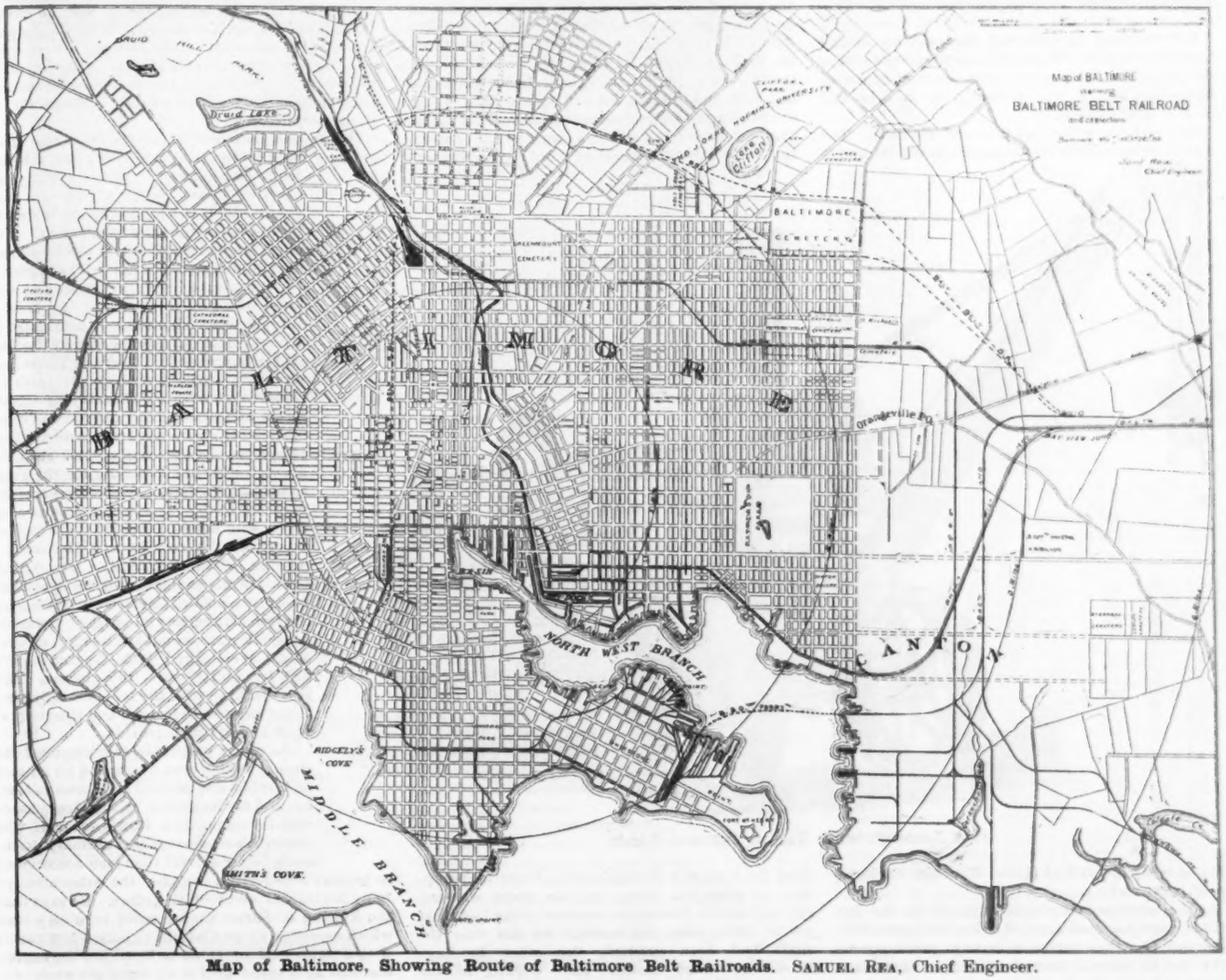
Now, placing a thumb in the hole at the end of the lever *a*, and a finger in like position on lever *b*, the three signals may be kept in line, one above the other, until the sounding is taken, when the hand is instantly removed to clamp the screw *C*, and the angles read at leisure.

The handle unscrews from the framework of the sextant and the levers *a* and *b* are easily removed, so that the whole instrument may be compactly boxed. The weight of the double sextant is very little more, if any, than the ordinary sextant. It strikes us as a novel and admirable instrument for all kinds of boat work on hydrographic surveys.

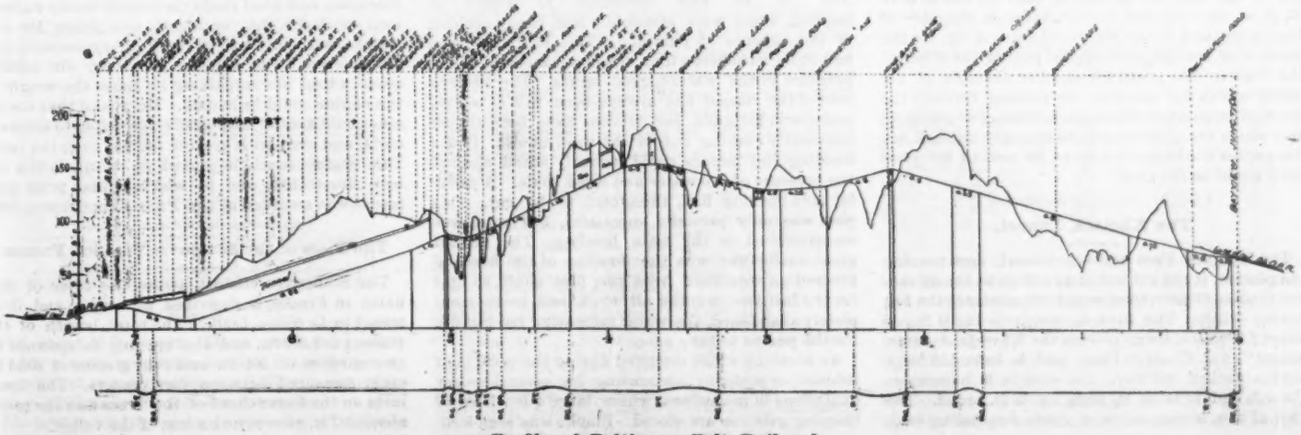
Baltimore Belt Railroad.

The accompanying map and profile show the proposed Baltimore Belt R. R., which it is proposed shall extend from a point on the Baltimore & Ohio R. R., about a quarter of a mile south of its Camden Station to Bay View Junction, a point on the same road about two miles east of the city. The route, as will be observed, is from Hamburg St. northward via Howard St. and through private property to the south side of Seventh St.; thence parallel with Seventh St., eastward to the Baltimore Cemetery, and thence south-eastward to Bay View.

The length of the road will be about 7 miles, more than 5 miles of which will lie within the city limits of Baltimore. The maximum grades will be 42 ft. per mile, equated on curves, ascending southward



Map of Baltimore, Showing Route of Baltimore Belt Railroads. SAMUEL REA, Chief Engineer.



Profile of Baltimore Belt Railroad.

and 74 ft. per mile, equated, ascending northward. The total length of the northward maximum grade does not, however, exceed one mile. The southward maximum of 42 ft. per mile was made to conform to the ruling gradient of the Philadelphia Divison of the B. & O. R. R.

Upwards of 1¼ miles of the road will be in tunnels. The tunnels will be four in number; the principal one, namely, the Howard St. tunnel, will be 8,350 ft. in length. Upon the entire line of the road there will not be a single street crossed, nor one used longitudinally, at grade.

There will be at least three important stations on the line, one a central city station in the business centre of Baltimore, and near Baltimore St.; the second on Boundary Avenue, not far from the Union Station, and the third in the northern (the growing) section between Charles and St. Paul Sts.

It is proposed to construct the road for double track throughout. The track superstructure will be composed of 90 lb. steel rail with the most approved fastenings, and it will probably be laid in rail lengths of 60 ft. each.

The bridging will be of iron and masonry. The road is estimated to cost complete $6,000,000, and it is to be ready for traffic in 1892. The chief engineer is Mr. SAMUEL REA.

As the necessary municipal authority of the city of Baltimore has been granted to the Baltimore Belt Railroad Co., that company is now preparing to construct its railroad through the city. When completed the Belt R. R. will be used by the B. & O. R. R. as an "all rail route" through the city of Baltimore, and by the Maryland Central Ry. for the purpose of reaching the central part of the city and tide water. The project is another example of the costly works for reaching or passing through the heart of large cities which are becoming so common, and which are quite certain to multiply until all our lines enter the larger towns so as not to interfere with street traffic at all.

A Locomotive for Use on Common Roads.

The Khojack Tunnel.

The Khojack Pass railway tunnel, now nearing completion, is the subject of an article in the *Allahabad* (India) *Pioneer*, from which we abstract the following details: The tunnel, which is 12,600 ft., or about 2.38 miles, long, pierces the Khwaja Ameran mountains at Khojack Pass, and is intended for a double-tracked railway. Its section is horseshoe-shaped, and it is 23 ft. high by 32 ft. broad. The floor of the tunnel is on a grade descending each way from a point near the center. The grade on the eastern side is 1 in 1,000, and that on the western side is 1 in 40. This grade was found necessary in order to effect drainage. The work of excavation was carried on from six headings, two shafts being sunk for that purpose, one on each side of the range. The shaft on the Quetta, or east side, is 318 ft. deep, and that on the Kandahar, or west side, is 290 ft. deep. The "English system" of driving the headings was followed. Compressed air drills were used in all the rock work, the engines for driving the machinery being located at the surface and the escaping air used to ventilate the tunnel. The heading has now been completed throughout and about 6,500 ft. of the lining is finished, completing this portion of the tunnel ready for the rails.

There have been two accidents in the history of the tunnel. The first was the flooding and consequent stopping of all work at the shaft on the Kandahar side of the range, and the second flooding of the heading proceeding beyond the first shaft on the Quetta side. In February, 1889, the western shaft had been finished only long enough to have enabled the heading to proceed about 700 ft. from its bottom in one direction only, when a large spring was cut, the water from which rushed down the heading and filled the shaft to a depth of 180 ft. Powerful pumps were at once put down, but the water was not emptied out for 10 weeks on account of the fresh supply of water from the spring. By the time the shaft had been emptied, the other headings from the west mouth had worked to the foot of it, and therefore 10 weeks of heading work were absolutely lost, to say nothing of the expense of pumping. This shaft has also had to be retimbered four times on account of the pressure of the water-logged strata. The western side of the tunnel has always been full of water, and about 500 galls. per minute have been almost constantly rushing out of the west mouth. In the heading the miners could scarcely stand against the pressure of the water and loose shale. A parallel side-heading had, therefore, to be cut. This plan was only partially successful, but work was recommenced in the main heading. The second great misfortune was the flooding of the heading proceeding westward from the first shaft, so that for the last two months all work had to be completely abandoned, the water increasing too rapidly for the pumps to keep pace.

An accident which occurred during the work is of interest as probably accounting for several recent explosions in magazines where large quantities of blasting gelatine are stored. Smoke was seen issuing from the ventilator of the large magazine at the mouth of the tunnel. Upon examination it was found that combustion had arisen inside a case of blasting gelatine. The fire had extended to several other cases of the same material, and charred the boxes containing the dynamite, about 20 tons of which were stored in the magazine.

The work of excavation was done by native workmen under the direction of English miners, and notwithstanding the difficulty of the work the progress was very satisfactory.

Road Locomotives.

Locomotive engines adapted for use on common roads are as yet comparatively little employed in this country, though their value in agricultural, mining and other industries, and in warlike operations, is fully recognized abroad. With the purpose of showing what they look like and giving some idea of the service to which they are adapted, an illustration is given herewith of a road locomotive crane engine made by the Aveling & Porter Co., of Rochester, England.

This engine, besides fulfilling the functions of an ordinary road locomotive in hauling heavy loads, has a crane attached to it for lifting and carrying heavy weights. It can turn sharp curves without slipping, is steered by one man, and can lift five tons. The crane is so arranged that it can be slewed at right angles to the axis of the engine.

The work performed by horses and road locomotives, on roads either bad or of a very ordinary character, is contrasted in a valuable official report issued by the Russian government just after the Turco-Russian war. Thirteen traction engines of various makes were used in carrying ammunition and transporting cannon and other material at a number of points during that campaign. In the case of two road engines, working at Portables on the Franteshti-Zimnitz line, a very correct account was kept of their service and cost as compared with horses. One of these engines was at work 8 months and the other 2 months. From this data it was figured that 12 of the engines, used for less than two years, not only completely reimbursed the purchase money and cost of maintainance, but also brought in a profit of over $5,300, as compared with the contractor's bids for similar work with horses. This resulted in spite of the fact that only some of the engines were used, and then only at short and irregular periods.

The report particularly commended the class of engine here illustrated for its ease in turning and general handiness in service, and for its ability to lift heavy loads with its crane. Col. DEMIANOVITCH, who makes this report says that ordinary smiths made better drivers than men accustomed to railway locomotives, because the latter attempt to go too fast in spite of all orders. He says that the Aveling & Porter engine could turn on a road which exceeded its own length by only a few paces; with a light load of 11,000 to 15,000 lbs. the engine traveled at a speed of 4 to 4½ miles per hour. On macadam and good roads the engine easily pulled a load of 90,250 lbs., or about five times its own weight, with only half of its ordinary pressure, and at a speed of 3.3 to 4 miles per hour. On country roads, a load not surpassing 1½ times the weight of the engine could be hauled. He found that the engine could ascend any grade accessible to ordinary carts, and even with greater facility than the carts. This engine, much improved in detail, is the one here illustrated, and to which a first prize gold medal was awarded at the Paris Exposition of 1889.

The Piers of the Souleuvre Viaduct, France.

The Souleuvre viaduct, across the river of that name in France, is described at length and illustrated in *Le Genie Civil*. The total length of the viaduct is 1,200 ft., and the opening is spanned by two girders of 104 ft. and four girders of 203.4 ft. each, measured between pier centers. The track rests on the lower chord of the truss and the rail is about 207 ft. above the bottom of the valley.

The two principal piers (Fig. 1) are nearly 200 ft. high each, and they are built of masonry after a somewhat exceptional design. The horizontal section of the pier is rectangular, with a strongly projected and ornamental coping, 8.72 ft. high. Just below this cap the pier has a horizontal section of 28.86 ft. by 13.12 ft., and at the base of the pier these dimensions are almost doubled. The sides of the pier show a gentle, bell-mouth curve made by ordinates located about 16 ft. apart. These piers were calculated to resist a maximum loading of 114 lbs. per sq. in., without wind pressure, and 171 ft. per sq. in. with a wind pressure of 54 lbs. per sq. ft.

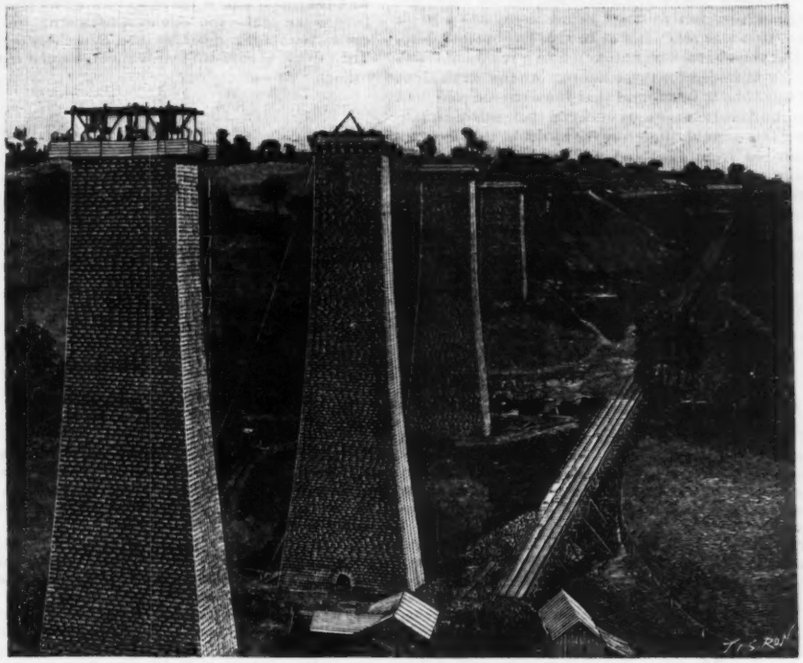


Fig. 1.—Piers of the Souleuvre Viaduct.

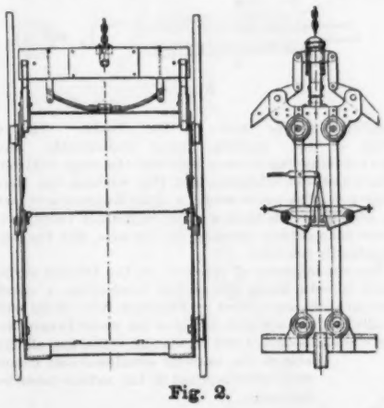


Fig. 2.

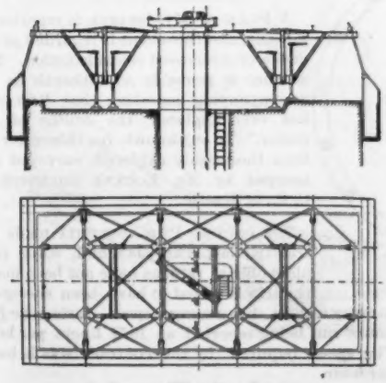


Fig. 3.

The profile used for the pier was adopted with the purpose of reducing the cube to a minimum, with out passing the limits given above and without exposing the masonry to tension. These conditions were found to be best filled by adopting for each face the curve made by a parabola of the second degree with a horizontal axis. Each pier was founded directly upon a bed of hard schist rock, and contained 7,280 cu. yds. of masonry each, including foundations.

The body of these piers was constructed entirely of cut stone, and to bring suitable material to the spot and to elevate it to the point of use were serious problems. Up to a height of 100 ft. the stone was lifted by an ordinary builders' hoist, operated by steam and working in a shaft left in the interior of the pier. For the work above 100 ft. a regular miner's cage (Fig. 2) was substituted running in the same shaft and properly provided with guides and safety appliances. The interior well was 3.9 ft. by 7.8 ft.

The scaffold shown (Fig. 3) was a light framework of iron connected by screw-bolts. This frame was lifted 3½ ft. as the work progressed by means of the eight lifting screws shown on the plan. The scaffold could be covered so that the men could work in the rainy season if deemed necessary. This arrangement proved very satisfactory in increasing the number of workmen and in hastening the work, and in also assuring almost absolute safety from accident. The defence from the action of the wind at so great a height was another decided advantage.

Cost of Street Lighting.

The councils of Kansas City have lately been investigating the cost of lighting the streets of that city, and the committee appointed for this purpose has just made its report. The city is now lighted by four private companies, including one gas company, two electric light companies and a "vapor light" company. The last company receives $2.25 per month for each 14 candle power lamp.

The committee prepared a set of questions, and sent them out to various cities, and the answers to them are scheduled as follows:

Schedule 1—Gas Lighting.

Name of City.	Schedule.	No. of lamps.	Cost of each per year.
Kansas City	Moonlight	1,482	$20.00
Baltimore, Md.	All night.	6,436	22.50
Binghamton, N. Y.	All night.	60	23.75
Birmingham, Ala.	Moon.	50	15.00
Buffalo	All night.	4,194	21.79
Chicago, Ill.	All night.	24,447	20.00
Cincinnati, O.	All night.	8,288	1.01 per M. ft.
Cleveland, O.	All night.	4,850	18.54
Milwaukee	All night.	2,200	24.17
Montreal	All night.	700	17.00
Philadelphia, Pa.	All night.	18,074	21.90
Richmond, Va.	All night.	1,275	Own their works.
St. Louis	All night.	601	30.00
Springfield, Ill.	All night	815	20.00

The advantage of a city owning its own gas works and supplying its wants and those of private consumers is strikingly shown in the experience of Richmond, Va. The following is taking from the annual report for 1889 of the Superintendent of Gas Works:

Received for gas		$185,451.31
Received for coke		21,501.50
Total		$206,952.81
Disbursed for pay roll	$78,795 74	
Disbursed for coal	60,420.04	
Expenses	9,346.42	
		148,562.20
Net receipts over expenditures		$58,390.61
To which must be added 43,1 5,687 cu. ft. of gas, consumed by street lamps and public buildings, at $1.50 per 1,000 ft.		64,703.53
Showing a total in favor of works of		$123,094.14

For gasoline light, which is indispensable in newly improved city districts, the return was as follows:

Schedule No. 2—Gasoline.

Name of City.	Schedule.	Number of lamps.	Cost per month.
Kansas City	Moon.	1,400	$2.25
Akron, O.	Moon.	450	1.34
Baltimore, Md.	All night.	859	.90
Chicago, Ill.	Both	8,608	1.08
Cincinnati, O.	All night.	1,708	1.03
Cleveland, O.	All night.	6,028	1.24
Columbus, O.	Moon.	600	1.31¼
Lancaster, Pa.	All night.	162	1.87
Lincoln, Neb.	Moon.	240	1.16⅔
Lowell, Mass.	7 h. per n.	416	1.60
Omaha, Neb.	All night.	900	1.41
Philadelphia, Pa.	All night.	6,476	1.75
Pittsburg, Pa.	All night.	3,100	1.00
Providence, R. I.	All night.	600	1.68
Sioux City, Ia	Moon.	300	1.40
Wichita, Kan.	Moon.	480	1.70

As to electric light, the following schedule shows the cost and power of the light as supplied by private corporations:

Schedule 3.

Name of City.	Schedule.	Number of lights	Cost per night, cents	Candle power.
Kansas City	All night.	114	55	2,000
Atlanta, Ga	All night.	506	53⅓	2,000
Baltimore, Md.	All night.	0:7	40	2,000
Binghamton, N. Y.	All night.	123	38	2,000
Birmingham, Ala.	All night.	100	33	2,000
Buffalo, N. Y.	All night.	1,206	40	2,000
Cleveland, O.	All night.	100	38	2,000
Denver, Col.	All night.	216	53	2,000
Duluth, Minn.	All night.	186	35	2,000
Jackson, Mich.	All night.	210	24	2,000
Lowell, Mass.	All night.	180	50	2,000
Memphis, Tenn.	All night.	100	50	2,000
New Bedford, Mass.	All night	90	40	2,000
New Haven, Conn.	All night.		48	2,000
Richmond, Va.	All night.	134	40	1,200
St. Louis, Mo.	All night.	1,587	30⅓	2,000
Sedalia, Mo.	Moonlight	91	24⅓	2,000
Springfield, Ill.	Moonlight	110	38¾	2,000
Troy, N. Y.	All night.	279	39⅓	2,000
Wichita, Kan.	All night.	90	30	2,000

The committee call attention to the fact that the smaller cities and towns using fewer lights are supplied at cheaper rates than cities with many lights; they think that if this condition is financially sound electric lighting is an exceptional business. For cities owning their own electric plant the committee present the following schedule:

Schedule 4.

Name of City.	Number of lamps.	Candle power.	Cost of each light per night.
Bay City, Mich.	134	2,000	.16⅔
Bloomington, Ill.	220	2,000	.20
Chicago, Ill.	520	2,000	.19
Hannibal, Mo.	98	2,000	.14⅓
Lewiston, Me.	96	2,000	.11⅔
Little Rock, Ark.	110	2,000	.13⅓
Madison, Ind.	85	2,000	.13⅓
St. Joseph, Mo.	208	2,000	.14⅓
Topeka, Kan.	184	2,000	.18

In closing their report the committee conclude that Kansas City is paying too much for her lights, and they recommend that an electric lighting plant be put into the basement of the new city hall (to be built), sufficient to light that building and the streets in the business part of the city. They also recommend that new contracts be at once made for all three systems of lighting, and that the street lighting be put under the control of the board of public works.

Expediency of a Change in Standard Height of Draw-Bars in Passenger Equipment Cars.

REPORT OF THE COMMITTEE OF THE MASTER CAR BUILDERS' ASSOCIATION, SUBMITTED AT THE LATE CONVENTION, JUNE 10.

Your committee has made inquiry with a view to ascertain the present condition of the passenger car equipment on the various railroads, and a table accompanying this report has been made up from information furnished by 52 railroad companies, and shows the number of cars equipped with the Janney, Miller, Cowell and Blackstone couplers. The table gives also the total number of cars, distributed under headings showing height of drawbars and the number of cars for each, measuring from top of rail to center of drawbar.

There are 13,720 cars reported, and of this number 7,668 cars have drawbars whose height is 35 ins.; while there are 4,428 cars having drawbars below this height, and but 1,624 cars measure more than 35 ins. Furthermore, it was found that there were 9,838 cars on which the height of drawbar could not be lowered, and that of the 1,624 cars now having drawbars above a height of 35 ins., 870 could be lowered to conform to 35 ins., leaving but 754 cars out of the total number of 13,720 which could not be lowered without expensive changes.

As is shown above, a majority of the cars have draw bars 35 ins. in height, and 4,428 cars are now below this and could be made to conform to it; and as the number above this height is comparatively small, your committee think it is expedient that there should be a change in the standard height of drawbars on passenger equipment cars, with a view to making it 35 ins. from top of rail to centre of draw bar.

SAFETY CHAINS.

Inquiry into the application of safety chains has shown that there are 9,604 cars on which they are used, and 4,116 cars running without them. As to the form of safety chains and their location, there was found a very great variety in practice, there being nearly as many forms of chains used and points selected for attaching them to the cars, as there were railroads using them. The differences, however, were so small that your committee think there would be little difficulty in adopting a standard and would make as their recommendation the following for a standard for safety chains on passenger equipment cars, viz.:

Links to be made of ¾ in. round iron.

One link, 4 ins. long by 1¼ ins. wide, measured inside, to be attached to the right hand side of platform, facing the end of car.

A chain consisting of two links and a hook, to be attached to left hand side of platform, facing end of car.

The link of this chain next to the platform, to be 2¼ ins. by 1¼ ins., measured inside.

The second link from the platform, to be 3½ ins. by 1¼ ins., measured inside, and

The hook to be 4 ins. long, taking the greatest distance measuring from the inside of the eye to the inside of the hook.

The chain made up in this way having a total length of 10 ins.

Respectfully submitted,

E. D. NELSON,
JOHN KIRBY,
H. MIDDLETON. } Committee.

Number of cars equipped with		
Janney coupler	4,625	
Miller "	8,949	
Cowell "	20	
Blackstone "	126	
Total	13,720	
Height of drawbars:		
35 ins.		7,668
Below 35 ins. (unspecified)	107	
33 ins.	1,807	
34 ins.	1,638	
34½ ins.	876	
		4,428
Above 35 ins.:		
35½ ins.	109	
35¾ ins.	34	
36 ins.	1,295	
44 ins. (Blackstone's	126	
		1,624
Grand Total		13,720

[The above propositions will be submitted to letter ballots.]

Frost-Resisting Cement Mortars.*

It being well known that Portland cement mixed with strong hydrochloric acid or with a saturated solution of soda, sets at once and becomes extremely hard, Mr. BERNHOFER carried out the following experiments with mortars composed respectively of Portland cement and sand, and lime and sand, each mixed with with a solution of crystallized soda (the temperature of the air being 22½° below zero, Fahrenheit) in order to observe the influence of frost on their quick-setting properties.

The exact composition of the mortars was 1 litre 1.76 pint) of Portland cement, and 1 litre of lime, each mixed with 3 litres of river sand, and a solution formed of 1 kilogram (2.2 lbs.) of crystallized soda and 2 litres of water.

The experiments commenced at 7:30 P.M. on Dec. 9, 1889, and continued till 10 A.M. on Dec. 10, a period of fourteen hours and half. During the night the temperature fell to 31½° below zero; at 8 A.M. on Dec. 10 it was 24¾°, and at 10 A.M. 15¾° below zero, when the mortars were taken into a room, and put into a hot oven for three hours. At the expiration of this time it was found that the extreme cold had had no disadvantageous effect on their setting qualities; there could, therefore, be no doubt that mortars prepared from Portland cement and lime with a solution of soda would withstand the injurious effects of frost. Mr. BERNHOFER, therefore, proposes further experiments to ascertain whether these mortars retain their hardness for a long period, and whether the larger quantity of soda used is absolutely necessary, as the cost of the mortar is mainly dependent on the amount of soda employed.

The cost of these frost resisting mortars, composed as above stated, is given as follows:

1 cu. yd. Portland cement mortar	$14.52
1 " " lime "	6.20

* Translated from *Wochenschrift des österreichischen Ingenieur- und Architekten-Vereines*, 1890, p. 16. Abstracts of Paper [illegible] C. E.

An Automatic Absorption Dynamometer.*

The desirability of maintaining a uniform load upon an engine used for experiments and tests, of accurately measuring the useful power developed by the engine, and of automatically regulating the rate at which energy is absorbed, led to the construction of the device herein described.

This dynamometer is essentially a friction brake, in which the pressure causing the friction is distributed over a comparatively large area, thus giving a low intensity of pressure between the rubbing surfaces. The pressure is produced by the action of water from the city pipes. Enough water is allowed to pass through the machine to carry off the heat due to the energy absorbed. The rubbing surfaces are finished smooth and run in a bath of oil. A valve operated by the slight angular motion of the dynamometer varies the supply of water, and consequently the pressure between the frictional surfaces, thus securing automatic regulation.

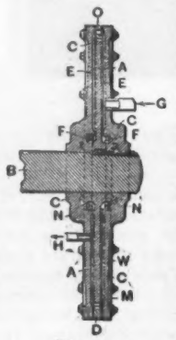


Fig. 1.

Referring to the drawings, *A* (Fig. 1) is an iron disk keyed to the crank shaft *B*. The sides of this disk are finished smooth, and each side has one or more shallow radial grooves as shown at *X* (Fig. 2). The outer shell consists of two pieces of cast iron, *CC*, bolted together, but held at a fixed distance apart by the iron ring *D*—whose thickness is the same as that of the disk *A*—and by the edges of the copper plates *EE*. Each of these plates at its inner edge makes with the cast-iron shell a water-tight joint by being "spun" out into a cavity in the iron and held by driven rings *FF*. Thus between each copper plate and its cast-iron shell there is a water-tight compartment, *WW*, into which water from the city pipes is admitted at *G*, and passing to the opposite compartment through passages, as shown at *O*, is discharged through a small outlet at *H*.

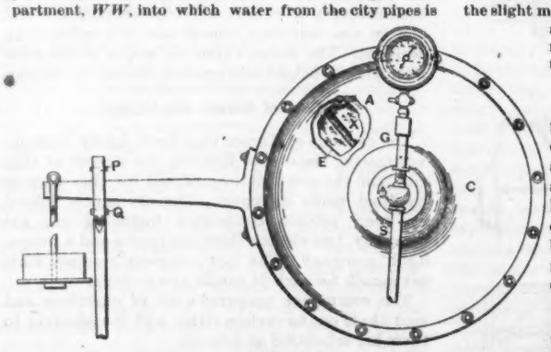


Fig. 2.

The chamber *MNN* is filled with oil, which finds its way from *N* to *M* along the grooves in the disk *A*.

The shaft is free to revolve in the bearings of the cast-iron shell *CC*. The shell has an arm carrying weights, as shown in Fig. 2. The arm has its angular motion limited by stops at *P* and *Q*.

* A paper by GEORGE J. ALDEN, Worcester, Mass., read at the Cincinnati Meeting of the American Society of Mechanical Engineers.

An automatic valve at *V* (Fig. 3), and shown in sections in Fig. 4, regulates the supply of water to the machine.

The valve consists of two brass tubes fitted one inside the other, but free to revolve relatively to one another. The inside tube has one end closed. Each tube has slots parallel or nearly parallel to its axis. One tube connects with the supply pipe *S*, the other tube with a pipe rigidly fixed to the brake and communicating with one of the compartments *W*. A flexible tube, *R*, encloses the whole. The valve is so adjusted that a slight angular motion of

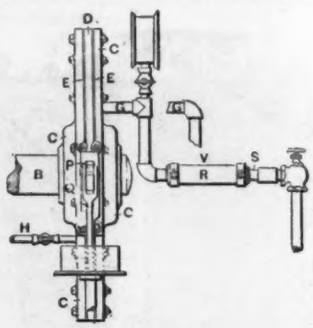


Fig. 3.

the brake varies the free water passage through the slots (see Fig. 4); and the aperture at *H*, through which the water is discharged, being small and constant, the pressure of the water in the chambers *WW* is thus automatically varied.

The dynamometer is operated as follows: The chamber *NNM* being filled with oil, weights are suspended from the arm to give the desired load. The engine is started, and when up to speed a valve is suitably opened in the water pipe leading to the automatic valve (*V*), which latter being open, allows water to pass to the compartments *WW*. The pressure of this water forces the copper plates against the sides of the revolving disk *A*—with which they were already in contact—causing sufficient friction to balance the weights upon the arm, which then rises. This motion operates the automatic valve, checking the flow of water to the brake and regulating the moment of the friction on the disk to the moment of the weights

Fig. 4.

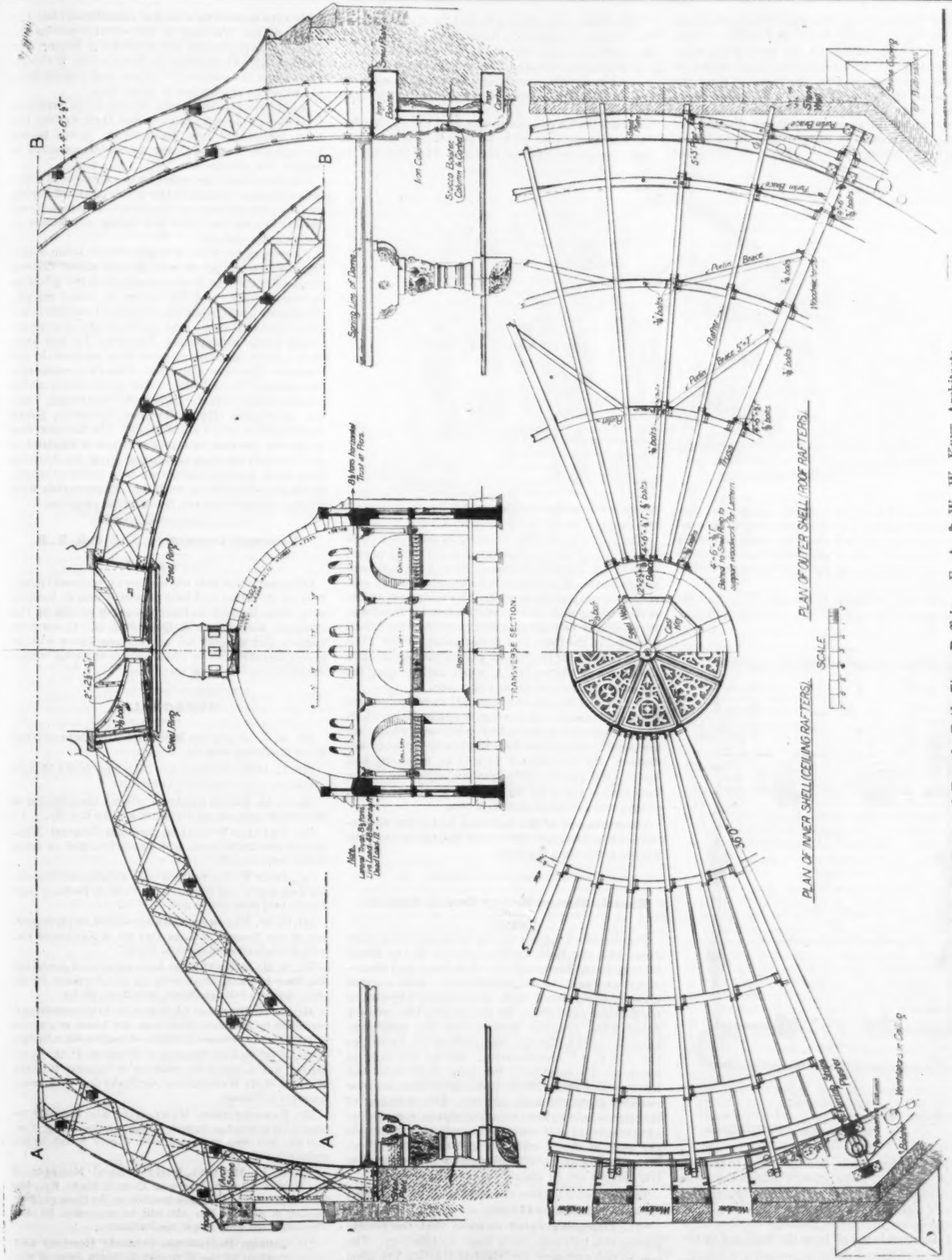
applied to the arm of the brake. The first trial of the machine gave remarkable results the arm standing midway between the stops, with only a slight and slow vibration, and this without the use of a dash-pot. The water seems a little sluggish in its action in response to the motion of the regulating valve, so that there is no sudden vibration of the arm, and the load is practically constant.

The low intensity of pressure at the friction surfaces, their smooth finish and perfect lubrication, a constant temperature maintained by a uniform flow of the cooling water, and the sluggish action of the water in response to the slight motions of the regulating valve, are all favorable to the unusual steadiness and complete regulation realized in the actual operation of the brake.

A PEAK OF MT. SHASTA is reported as missing, and this event is regarded as evidence of a renewed volcanic action. This account is propably as authentic as the accompanying assertion that "no man has ever explored the depths of the crater." To our knowledge this crater has been thoroughly explored, surveyed and mapped by Mr. EUGENE RICKSECKER, C. E., of Seattle.

THE CRUISER PHILADELPHIA made her trial trip last Thursday, and, while complete official returns have not been made, the trip is stated to have been successful in every respect, her average speed during the four hours' run being reported as 19.51 knots per hour. The speed required in the contract was 19 knots per hour.

THE LONDON TOWER is so far on its way to become an accomplished fact that a site of 300 acres has been purchased. One-half of this ground will be used for the site of the tower and the other half will be laid out in pleasure grounds.



Wooden Dome of Temple Beth Zion, Buffalo. E. A. & W. W. Kent Architects.

A Large Wooden Dome.

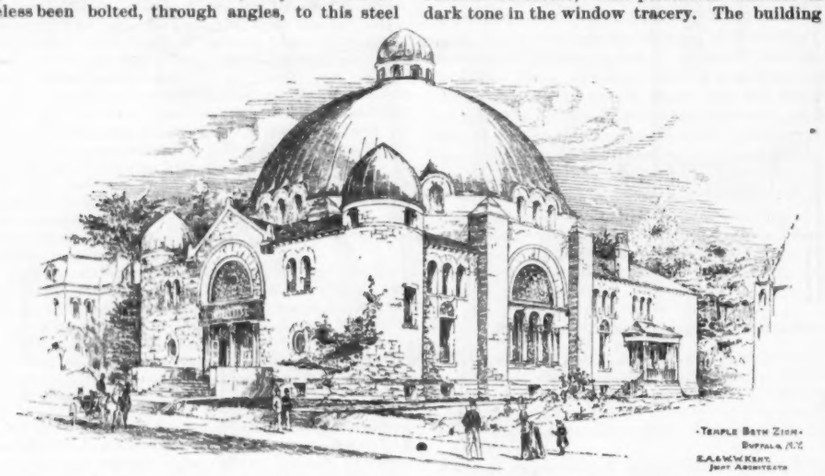
We give herewith some interesting constructive details of a very unusual form of domed church lately completed at Buffalo, N. Y., from drawings by Messrs. E. A. & W. W. Kent, architects. The decidedly Oriental appearance of the exterior suggests at once that it may be a Jewish synagogue, which it is, its formal name being the Temple-Beth Zion.

Apart from the merit of the design to archeologists or architects, as to which we could only give impressions entitled to little weight, the point of mere engineering interest is the dome, constructed, as it is, very economically, and yet of great strength and rigidity.

The roof is of 12-oz. copper, fastened by cleats without solder to the roof-boards—the seams being locked over horizontally and left standing vertically. The matched boards are laid on diagonally and in narrow widths, to secure the warp of the wood to a true sphere, the frequent nailing for this requiring rafters not generally more than 24 ins. apart. As will be noted in the roof section, the plastered ceil-

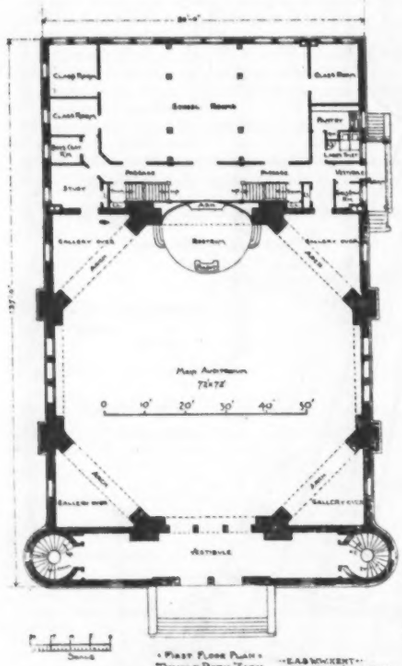
ing is 4 ft. away from the copper roof, the space being used to diagonally brace and strut the ordinary 4 in. × 12 in. rafters on the same principle as the large trusses. The main strains are shown on the small transverse section, the thrust of the dome being taken up by the flat steel ring at the top of the piers, under the dome.

While the lateral thrust is slight at the base of any one of the trusses or rafters, they have nevertheless been bolted, through angles, to this steel



base plate, which is ⅛ in. × 20 ins. octagon on plan resting on the masonry at the inside face of the wall and bolted every 5 ft. to 5 and 8-ft. vertical anchor rods in the walls. These are bent back on themselves and riveted to the cast-iron bolsters in the eight corners.

A simple and effective anchorage is further secured by bolting the bases of the cast-iron columns



to their supporting corbels, and their tops to the bolsters, and then bolting the bolsters to both the outer and inner chord of the truss and to the octagon steel plate above mentioned. This carries a large part of the weight down below the galleries as the inner chord of the truss is set off from the wall and on the column.

The cost of the dome, which is 80 ft. in diameter, was:

Carpentering, complete	$4,500
Ironwork, complete	1,325
Copper roofing and felt	1,900
Total	$8,025

Bids for the dome in iron were about $11,000.

Dimension stone (flint) was laid for the large piers to a height of about 10 ft. from grade; thence they were built of brick—the arches being also of brick.

Georgia pine was used for the framing, the purlins being 1 in. boards, sprung to a curve and allowed to run through the rafters, but not through the truss chords.

A dark brown sandstone was used for the entire exterior structure, with perforated marbles of a dark tone in the window tracery. The building is the only one of the kind of such large roof span in the country, so far as we know.

The entrance to the building is through a vestibule, 92 ft. by 14 ft., terminating in the round towers from which circular stairways lead to the basement and galleries. The interior is finished in antique oak, richly carved and decorated. The main auditorium is 80 × 80 ft., and is entirely roofed by the dome. By a circular pew arrangement, seatings for 700 are provided in the floor, and accommodation for 150 is found in the four triangular galleries constructed in the angles of the walls. A small gallery over the rostrum contains the choir and organ.

On the first floor in the rear of the auditorium are the school rooms, occupying a space 80 by 42 ft. These rooms are separated by partitions which are arranged to be lowered into the basement when not desired. On the second floor is an assembly hall seating 350 people, with parlors adjoining. The basement is taken up by the furnaces, fuel rooms, toilet rooms, kitchen, pantrys, etc.

The entire cost of the building, including decoration and furnishings, was under $50,000, or less than $42,000 apart from the dome.

Electric Storage Battery Cars in England.

The Electric Traction Co. has been operating since June, 1889, the Barking Road section of the North Metropolitan Tramway Co. (London), and the results are said to be satisfactory. Accumulator cars are used, fitted with the company's system of mechanical application of the power; the cars are fitted with Immisch motors and the secondary batteries of the Electric Construction Co., known as the "E. P. S." accumulators. During the time of operation the cars have run over 80,000 miles and have carried about 750,000 passengers; they are now running about 300 miles per day. The working of this line is said to have established the commercial advantages of self-contained accumulator cars in the case of street railways in large towns, where underground and overhead conductors for the electric current are (or should be) inadmissible.

The following is from the last report of the North Metropolitan Tramway Co.:

"The directors are glad to state that the results during the half-year have been satisfactory. The cost to this company for electric traction has been 9 cts. per mile (including the wages of drivers), which is less than the average cost per mile run for horse traction over the entire system. The Barking Road section is a short single line with loops, which does not offer such facilities for economic working as a longer line would with a higher mileage and more cars worked by a larger installation; but the result of the working of the electric cars on the Barking Road justifies the directors in hoping that Parliament will sanction the introduction of electric power over the company's system, and enable them to extend its application to other lines."

A bill to enable the North Metropolitan Tramway Co. to adopt electric traction over their system has been introduced into Parliament. It has passed through the House of Commons, and is expected to become law this session.

Street railway companies have experienced many disadvantages attending the employment of horses, and, as each electric car supplants ten horses, it will readily be seen that there is a strong inducement to seek for the change.

As economy of 2 cts. per mile would mean a saving of $1,300,000 per annum to the street railway companies of Great Britain, apart from the profit on increased traffic, and the saving to street railway companies by the adoption of electric traction should far exceed that sum. One result of the experience of the North Metropolitan Tramway Co. has been that several applications have been received by the Electric Traction Co. from tramway companies throughout the country. The applications under consideration include Liverpool, Edinburgh, Dublin, Newcastle, Hull, Bradford, Leicester, South Staffordshire, and Vale of Clyde. The introduction of electric traction on street railways in England is not likely to be very rapid; and even in America they are in general introduced only where overhead wires are permitted to be used. Experiments with storage battery cars are, however, in progress.

Passenger Locomotive, C., B. & Q. R. R.

[WITH INSET.]

Our inset sheet this week shows a sectional longitudinal elevation and half plan of a mogul locomotive, Class H, used in fast passenger service on the Chicago, Burlington & Quincy R. R. In our next issue a full description of this locomotive will be given, accompanied by illustrations showing transverse sections and end elevations.

PERSONALS.

Mr. A. J. GRANT has been appointed Superintendent of the Orange Belt Ry., Florida.

Mr. J. MCNAUGHTON has been appointed Master Mechanic of the Wisconsin Central Ry.

Mr. G. M. BEACH has been offered the position of General Manager of the Pittsburg & Lake Erie Ry.

Col. CHARLES WILLIAMS, formerly General Manager of the Little Rock & Memphis Ry., died in Little Rock, Ark., June 20.

Col. JOHN Y. CULYER has been appointed Consulting Engineer of the Brooklyn, N. Y., Park Dep't., a position he held from 1866 to 1886.

Mr. G. W. BALCH has been appointed Superintendent of the Tacoma & Lake City Ry. & Navigation Co., with headquarters at Tacoma, Wash.

Mr. E. H. MCHENRY has been appointed Assistant Engineer in charge of all work on the Northern Pacific Ry., between Billings, Mont., and Hope, Idaho.

Mr. C. W. BUCKHOLZ has accepted the position offered him by President Howell, on the board of experts to consider the terminal facilities of the Brooklyn Bridge.

Mr. J. W. CLOUD, Secretary of the M. C. B. Association, has accepted the position of General Western Manager of the Westinghouse Air Brake Co., with headquarters in Chicago.

Mr. BARTHOLOMEW MURTAUGH, who recently resigned his position as Superintendent of the Jersey Central Ry., has been presented with a gold watch by the employés of the road.

Mr. W. F. MERRILL, lately General Manager of the Kansas City, St. Joseph & Council Bluffs Ry,, has beed appointed to a similar position on the Chicago, Burlington & Quincy Ry. He will be succeeded by Mr. BROWN, of the Iowa line of the Burlington.

Mr. GEORGE B. HARPER, formerly Receiver and Superintendent of the Kentucky & South Atlantic Ry. and Superintendent and Chief Engineer of the Cincinnati & Green River Ry., has been appointed General Manager of the Kentucky Midland road, with headquarters at Frankfort.

Mr. CHARLES PAINE, ex-President Am. Soc. C. E., and well known to nearly all our readers, has formed a

partnership with two of his sons, and opened an office in this city under the firm name of CHARLES PAINE & SONS, as consulting engineers, making a specialty of railway work, in which Mr. PAINE has had nearly a half century of experience. Mr. PAINE will shortly make his permanent home at New York.

Mr. GEORGE PARKER, an Engineer from the Gulf City, has been appointed Superintendent and Engineer of the Galveston (Tex.) water-works, vice JOHN COTTER, resigned. He will enter upon his new duties on July 1.

Mr. ROBERT VAN BUREN, Chief Engineer of the Brooklyn Water Department, and Mr. SAMUEL R. GRAY, of Providence, R. I., formerly City Engineer of Providence, have been engaged as Consulting Engineers by the Sewerage Committee of the Orange (N. J.) Common Council to report upon the plans submitted by CARROLL PH. BASSETT, C. E., for the new sewerage system.

MR. CHARLES ACKENHEIL, M. Am. Soc. C. E., died from injuries received in an accident on the Baltimore & Ohio R. R. on June 20. He was born in Baden-Baden in 1812, and was educated at the University of Heidelberg. He came to this country about 20 years ago, and at once entered the service of the B. & O. R. R., and he has been connected with this company ever since, except for a brief period, when he was employed by the Rochester & Pittsburg R. R. The Arthur Kill bridge and the Pittsburg & Wheeling R. R. bridge, over the Monongahela River, were built under his supervision, and at the time of his death he was Chief Engineer of the New York extension of the Baltimore & Ohio R. R., Staten Island Rapid Transit R. R., and the Baltimore & New York R. R.

PUBLICATIONS RECEIVED.

Report on Proposed System of Water-Works for the Town of Galt, Ontario. Pamphlet, 16 pp. and folding map. By Willis Chipman, M. Am. Soc. C. E., Toronto, Ont.

—Seventh Annual Report of the Board of Railroad Commissioners of the State of New York for the fiscal year ending Sept. 30, 1889. Two vols., 6x9¼ in., cloth bound, 976 pp. Commissioners, Wm. E. Rogers, Isaac V. Barker, Jr., and Michael Rickard.

—Mechanics of the Machinery of Transmission is announced as in preparation by John Wiley & Sons, publishers, New York. This is Vol. III., part I., sec. II. of Mechanics of Engineering Machinery, by Dr. Julius Weisbach, edited by Prof Gustav Hermann and translated by Prof. J. F. Klein, Lehigh University, Bethlehem, Pa.

—Bankers' and Brokers' Reference Book. A Birds' Eye View of the Financial Field of Investment Securities. BY ALFRED SMITH, New York American News Co., 12mo. pp. 60.

This little book gives prices for all kinds of securities of any standing, for two to six years back, with some miscellaneous financial information.

—Twelfth Annual Report of the State Board of Health of Connecticut for the year ending Nov. 30, 1889; with the Registration Report for 1888. Pamphlet, pp. 268, 195. C. A. LINDSLEY, Secretary.

This is a full report of its kind, but it contains very little matter of direct interest to engineers. The death rate for 1889 was 16.6 per 1,000, against 17.1 in 1888.

—The League Island Navy Yard. Report of Naval Board on the Availability of the Navy Yard at League Island as a Naval Station and Ship-building Yard. Pamp. Pub. Doc.

A very elaborate and interesting report and estimate of the cost of making a modern yard of the first class at League Island, fully illustrated. A full outline of the project was given in ENGINEERING NEWS of Nov. 23, 1889.

—The Disposal of Household Wastes: A Discussion of the best Methods of Treatment of the Sewage of Farm-houses, Isolated Country Houses, Suburban Dwellings, Houses in Villages and Smaller Towns, Hospitals, Asylums, Prisons, Hotels, etc., and of Disposal of Garbage and other Solid House Refuse. By WM. PAUL GERHARD, C. E. New York, D. Van Nostrand & Co. Small 12mo, paper boards, pp. 195; 50 cts.

The scope of this little work is almost completely indicated by its title, and, so far as we have been able to examine it, it appears an excellent and timely little manual.

—Topographical Map of Staten Island. Scale, 4 ins. to 1 mile. J. R. Bien, publisher, 71 Broadway, New York. Price, to fold, $18.00; as wall map, $15.00.

This is undoubtedly the largest and most complete map of Staten Island ever published, and the first map of its class published in the United States by private enterprise. It shows township and village lines, post offices, railroad stations, all villages, roads, lanes, fence lines, houses of all kinds, streams, etc. It is contoured at every 10 ft., and shows the official pier and bulkhead and boundary lines as recently determined. It is more detailed than any Government or State survey, and in execution leaves nothing to be desired. In general style it is similar to the State maps of New Jersey, so highly commended, and also executed by Mr. Bien. The map is made from original surveys by Messrs. Vermeule and Bien.

—Third Annual Report of the Board of Public Works, Duluth, Minn., for the year ending Feb. 28, 1890. Pamphlet, 104 pp. WM. B. FULLER, City Engineer.

There is included in the above a report on the extension of the sewerage works, by Rudolph Hering and Andrew Rosewater, Consulting Engineers; also a plan for a combined railway and highway bridge across the ship canal on Minnesota Point, by Alfred P. Boller, C. E. A sheet of illustrations shows in some detail the bridge proposed by Mr. BOLLER, and a large map of the city, the proposed sewerage system.

Messrs. HERING and ROSEWATER were asked to outline sections of streets and alleys best adapted for steep hillsides; to give plans of street intersections on steep grades. They illustrated this part of their report with three pages of plans, sections and details.

The reports of the Board, its Clerk and City Engineer FULLER gave in detail the work done in the past year, and the present condition of the public improvements. There were on Feb. 28, 55 miles of graded streets and alleys, 2.9 miles of paved streets, 5.98 miles storm sewers, 15.87 miles of sanitary sewers, and 48.7 miles of sidewalks. Under the direction of E. J. DUFFIES 1,713 cement briquettes were broken in 1889 in testing the cement used on the public works. The results are included in the report, in tabular form, and are also shown graphically by diagrams.

—Annual Report of the State Geologist of New Jersey for 1889. IRVING S. UPSON, New Brunswick, N. J., Assistant in charge.

This report deals with the progress made in the geodetic survey, Prof. E. A. BOWSER; the geological studies of the Archæan rocks, Mr. FRANK L. NASON, Assistant Geologist; geological studies of the Trassic or red sandstone and trap rocks; drainage, by Mr. GEORGE W. HOWELL, C. E.; water supply and artesian wells, by Mr. C. C. VERMEULE, C. E., and artesian wells of Atlantic City, by Mr. LEWIS WOOLMAN. Mr. HOWELL reports the rainfall of 1889 as being nearly 65 ins., while the average of the last 45 years is 46¼ ins.; only two years in all that period approach 1889, viz., 1859 and 1888, with 57 ins.

Mr. VERMEULE presents a very valuable resumé of the condition of water supply for towns and cities in the State. After noting the new Newark supply and the proposed supplies of Jersey City, Orange, Camden and other towns, he shows that an aggregate of 11 towns in the State, with a population of 455,823, are in trouble from foul supplies and the pollution of streams by other towns. The works involved represent an aggregate cost of $10,000,000. Ten towns and villages, aggregating 30,000 inhabitants, have now under construction or are projecting their first water-works; of these Plainfield is the largest, with 8,913 inhabitants in 1885. This town has for some past been the largest east of the Mississippi unsupplied with water. At least six out of these ten towns will derive their supply from open or driven wells. Of the 56 water-works in the State, 43 have streams for their source and 13 draw from wells; 38 of the towns are supplied by private companies and 18 own their own works. Among these private supplies are Paterson, 63,273 inhabitants; Hoboken, 37,721; Elizabeth, 33,119. Mr. VERMEULE thinks the time has come for a more direct and active control of water supply by the State, owing to the pollution of streams by various towns and the difficulty of adjusting rival or conflicting interests.

The abundance of pure and wholesome water to be obtained from artesian wells is being more and more appreciated, and the report deals in some detail with the new wells bored at various points in the State since the full account given in previous reports. Mr. WOOLMAN notes that four wells have been bored, in the past three or four years, at Atlantic City by the Consumers' Water Co. Full detail of the strata penetrated is given for each. No. 1 well is 1,150 ft. deep; No. 2 was abandoned at 315 ft., owing to an accident; No. 3 is 1,400 ft. deep, or the deepest north of Charleston, S. C., on the Atlantic coast, and No. 4 is 578 ft. deep. The first and last wells supply good, fresh water. The account of strata passed through and the fossils found in several of the later ones is a valuable contribution to our knowledge of the earth's crust in that section of the State.

SOCIETY PROCEEDINGS.

Engineers' Club of Kansas City.—Meeting of June 9. Vice-President Mason in the chair. Ten members and one visitor present.

A letter from the President, tendering his resignation on account of proposed absence, was read, but it was voted, on motion of Mr. Stone, that the Secretary ask him to remain in office until the annual election of officers.

After a general discussion on Gas Engines, it was voted, on motion of Mr. Talmage, that the chair appoint a committee to make all necessary arrangements for the annual excursion Messrs. Goldmark, Taylor and Talmage were appointed.

On account of the unavoidable absence of Mr. Gillham, it was decided to invite him to present his talk on the *City of Paris* accident at a special meeting to be announced.

KENNETH ALLEN, Secretary.

Engineers' Club of St. Louis.—Meeting June 18. Vice-President Burnett in the chair; 17 members and 3 visitors present.

A paper by Prof. Chas. C. Brown was read by the Secretary on "River Pollution in the U. S." The author divided the treatment of his subject into three heads: First, streams used for water supply only; second, streams used for drainage purposes only; third, streams used for both water supply and drainage. The paper was confined principally to the consideration of the latter class, it being the most important. The author gave abstracts of the work done in different States heretofore, in the direction of investigating the pollution of streams, accompanying his remarks by tables showing the results of chemical analysis of a large number of different waters. The author said he would be glad to receive further data, and asked for criticism and discussion of the subject. After brief discussion by Messrs, Beahan, Seddon and Holman, the meeting adjourned.

WM. H. BRYAN, Secretary.

The Institution of Civil Engineers.—The annual general meeting of corporate members took place June 3, Sir John Coode, K. C. M. G., the President, being in the chair. The meeting was held on the sixty-second anniversary of the incorporation of the Institution. At that time the number of members was 156, and the gross annual receipts were £447. At the close of the past financial year the number of members was 5,872, and the gross receipts for the twelve months amounted to £22,478.

The roll of the Institution, exclusive of Students, showed a net increase of 164, the number of members of all classes (irrespective of Students) being now 4,903. This represented an increase at the rate of about 3½ per cent. per annum. Owing to more stringent regulations as to the admission of Students, there had been a decrease of 20 in the number of that class. The admissions had included 156 Students, and one was restored to the list, while 73 had been elected associate members and 104 had passed from the list.

Since the last annual meeting four volumes of Minutes of Proceedings had been issued. It was intended shortly, to issue a pamphlet of about 60 pages, enumerating those public educational establishments in the British dominions which included special preparation for the engineering profession.

The abstract of receipts and expenditure showed, on the credit side, income £17,677 13s. 10d.; capital (that was admission fees and life compositions), £3,795, trust fund receipts, £1,005 (including the Crampton Bequest of £500 and the Trevithick Memorial Donation, £100), making a total of £22,478.

The general expenditure had been £14,696; the investments on account of capital, £6,091, and payments or investments of trust funds, £1,049. The Institution investments make a total of £104,186.

The report referred to the visit last summer to Europe of a representative body of members of the American Societies of Civil, Mining, Mechanical and Electrical Engineers, which the Institution had the honor of entertaining for six days. Many and various were the means which the Reception Committee took to arrange for the amusement and recreation of the visitors. On the whole, the visit might be considered to have been a great success, and was one full of pleasant memories for the hosts.

The following is a detailed list of awards made for communications submitted during the past session:

FOR PAPERS READ AND DISCUSSED AT THE ORDINARY MEETINGS.

Telford Medals and Premiums to JOHN ROBINSON for paper on "The Barry Dock Works, including the Hydraulic Machinery and the Mode of Tipping Coal;" to C. O. BURGE for account of "The Hawkesbury Bridge, New South Wales;" to FREDERICK T. G. WALTON for description of "The Construction of the Dufferin Bridge over the Ganges, at Benares." Telford Premiums were awarded to S. W. BARNABY for paper on "The Screw Propeller;" to W. H. WHEELER for paper on "Bars at the Mouths of Tidal Estuaries;" to J. PRICE, Jr., for account of "Lough Erne Drainage Works." The Manby Premium to W. P. J. FAWCUS and to E. W. COWAN for joint paper on "The Keswick Water Power Electric Light Station."

Telford Premiums to C. HOPKINSON for paper on "Hydraulic Packing-Presses;" to H. G. SHEPPARD for paper on "The Reclamation of Lake Aboukir, near Alexandria Egypt;" to WILFRID AIRY for papers "On the Action of Quicksands" and on "The Probable Errors of Surveying by Vertical Angles."

AWARDS TO STUDENTS FOR PAPERS READ AT THE SUPPLEMENTAL MEETINGS OF STUDENTS.

The Miller Scholarship to C. F. JENKIN, for paper on "Some Applications of Electricity in Engineering Workshops;" Miller Prizes to C. H. WORDINGHAM for paper on "Telephonic Switching;" to A. E. YOUNG for account of "The Deflection of Spiral Springs;" to L. A. LEGROS, for paper on "Economy Trials of a Compound Mill-Engine and Lancashire Boilers;" to F. P. REYNOLDS, for description of the "Roof over the Carlisle Markets;" to Geo. HALE, for description of the "Hydraulic Station and Machinery of the North London Railway at Poplar;" to G. H. SHEFFIELD, for paper on the "Principles of Iron Foundry Practice.

It has been determined to print the first three Students' papers, either in whole or in part, in the Minutes of Proceedings.

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CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if those who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, July 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting, July 7. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Club, Cleveland, O.—Next meeting, July 7. Secy., C. O. Palmer, 22 Cedar Ave.

American Society of Civil Engineers, New York.—Annual convention now in progress at Cresson, Pa. Secy., John Bogart, 127 E. 23d St.

Western Society of Engineers, Chicago, Ill.—Next meeting, July 2. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex.—Next meeting, July 4. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia, Pa.—Next meeting, July 5. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, July 9. Secy., J. C. Herring, Wichita.

New York Railway Club.—Next meeting, July 17. Rooms, 113 Liberty St.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, July 10. Secy., Olin H. Landreth, Vanderbilt University.

Engineers' Society of Western Pennsylvania.—Next meeting, July 15. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, July 16. Secy., S. E. Tinkham, City Hall.

American Society of Railway Superintendents, Boston, Mass.—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave.

Engineers' Club of St. Louis, Mo.—Next meeting, July 2 Secy., W. H. Bryan, 30 South 7th St.

THE attention of those of our readers who are interested in contracting intelligence is specially directed to the number and scope of the advertisements for proposals which appear in this issue. The causes which have led to the popularity of this journal for this purpose are referred to in another column.

WE are aware of no American technical journal which is in the habit of appropriating articles of any length or importance from foreign journals without duly crediting them, although we need hardly say that there are a multitude of second and third-class journals in this country which are not over-scrupulous in many of their procedures. We observe that the second and third-class English journals, however, are by no means so scrupulous; and one of the coolest instances of wholesale appropriation which we have ever chanced to note appears in the last issue of the *Railway Press*, of London, a monthly journal of some pretensions to respectability and standing. It appropriates bodily a two page description of the Coteau Bridge from our columns, including eight illustrations, carefully erasing our mark from the latter, and even including in its steal our closing words of acknowledgment that "To Messrs. —— our readers are mainly indebted for this description," and "To Mr. —— we are indebted for the points given in the latter part of this description"! We realize that the citizens of a nation which persistently refuses to respect the property rights of foreign authors in their own productions are not entitled to say much about wholesale stealing, however innocent they may be individually of that wrong and shame; and we will not say much. But the ordinary courtesies of journalism are apart from this question, and are not affected, nor would they be, by action or non-action on it.

WE learn that some of our readers have been misled into the belief that the "Notes from Abroad" (*Editorial Correspondence*) in our last issue were written "in advancé," because a personal in the same issue announced the departure for Europe on June 18 of Mr. D. McN. STAUFFER of the editorial staff of this journal. Inasmuch as the "Notes from Abroad" described particularly the Inman steamship *City of New York*, while the personal item stated that Mr. STAUFFER had just sailed on that vessel, any one unacquainted with the ENGINEERING NEWS or with Mr. STAUFFER might, perhaps, reasonably have supposed that the description of the steamer and the notes on English railways were prepared by Mr. STAUFFER before his departure.

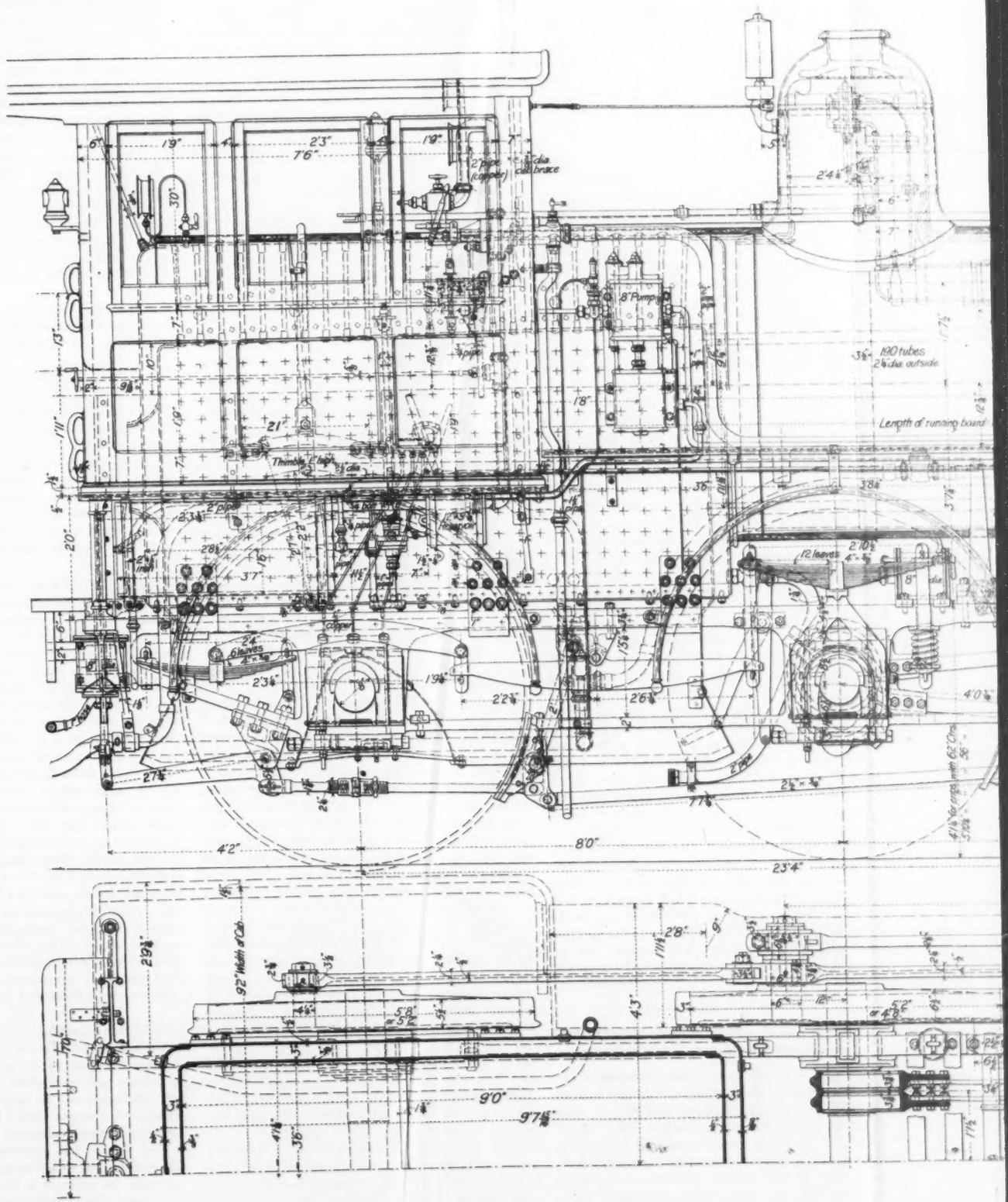
To those familiar with our columns, however, we need hardly say that the ENGINEERING NEWS does not present matter in its columns which is anything else than what it purports to be. Mr. STAUFFER or any other writer on its staff is *not* accustomed to describe events as happening under his own personal observation which did not so happen. To satisfy the curiosity of any who may have noticed both the personal concerning MR. STAUFFER and the "Notes from Abroad," we will say that the latter article was from the pen of Mr. E. E. RUSSELL TRATMAN, of the editorial staff of this journal, who sailed for Liverpool on the *City of New York* on May 21.

KANSAS CITY is making a sensible move in so amending its city charter as to require the president of the board of public works to be a civil engineer and to perform the duties of the city engineer at the same time. This change is proposed owing to the present absurd conditions of a $4,000 city engineer reporting as a subordinate to a board whose members draw $1,000 each per annum. But it is also a move in the right direction, regardless of unbalanced salaries, and other cities would be wiser than they are were they to follow the example of Kansas City and put the responsible charge of their engineering work into the hands of engineers, rather than with those who are only "good citizens," or are more generally good politicians. There is money for the city in the change, and it is in accord with the true principles of better municipal government.

THE latest news from Nicaragua is that men and supplies are arriving fast, but not quite fast enough to suit the contractor who is building the first twelve miles of railway inland across the flats to the great divide cut. That work is expected to be finished shortly, however. It is a necessary preliminary to the working of any large force of men to good advantage. A further fact of some significance is that among the higher officials, who confine their drinking to Apollinaris or other imported water, good health prevails, but among the working force, who go to the nearest spring or brook for water, there has been some tendency to malarial fevers. The last is to be expected in working across the twelve miles of flats, if not on the great cut; but if so slight a difference as the use of different water for drinking will affect the health of the working force, as it is quite probable that it will, the difficulty can be readily and cheaply gotten over by the use of the ordinary distilling and aerating plant, which is now all but universal on large steamships.

It is not to be expected that a great work of this kind can be carried on in a tropical country without more or less trouble from malarial fevers and other diseases of that class; but all that we hear about the climate and other working conditions at Nicaragua (and we hear a good deal) confirms us in the belief, which we have often expressed, that the climatic conditions at Nicaragua and Panama are totally different, and that nothing more than ordinary care and caution will be needed to insure good health in the working camps. Another important fact is that the experience so far gained seems to indicate conclusively that the proposed comparatively inexpensive plans for improving the harbor of Greytown will be entirely successful. Altogether, the prospect for the early and successful construction of the canal never seemed better than now.

THE great firm of Wm. Arroll & Co., builders of the Forth Bridge, have lately performed a feat which seems to be regarded in England as somewhat remarkable, since it is described at some length in the English technical journals as an "interesting engineering feat." They succeeded in replacing an old bridge by a new and larger one with a total interruption to traffic of "only seventeen hours," the total weight of the two bridges being given as 400 tons, from which we infer that the old bridge weighed about 150 tons. As compared with what has been repeatedly done in this country, however, this reads like a poor performance indeed; something to be ashamed of rather than proud. Not to speak of the innumerable bridges which have been erected in place around or on old bridges, without interrupting traffic for a moment, in our issue of Oct. 22, 1887, we described and illustrated at length the removal of a bridge on the Pennsylvania R. R. 349 ft. long and weighing 450 tons, and 60 ft. over a large river instead of just above some other tracks, in a total time of 15 minutes; the new bridge being in place, the track connected, and traffic running over the new bridge, with a total delay of 80 minutes only from the time the rails were broken over the old bridge. In our issue of Aug. 24, 1889, we gave another instance where even better time (12 minutes) was made with a bridge weighing 250 tons, and in all there have been a dozen or more such quick removals, perhaps, made within the last five years in this country, until it has come to be an axiom that under no conditions is there any necessity for interrupting traffic more than a few minutes for renewing a bridge of any ordinary span. It is, therefore, with some surprise that an American finds a change of this kind made in seventeen hours regarded worthy of note as a creditable performance, especially when the cheapness of the plant used in this country for the quicker changes is remembered.



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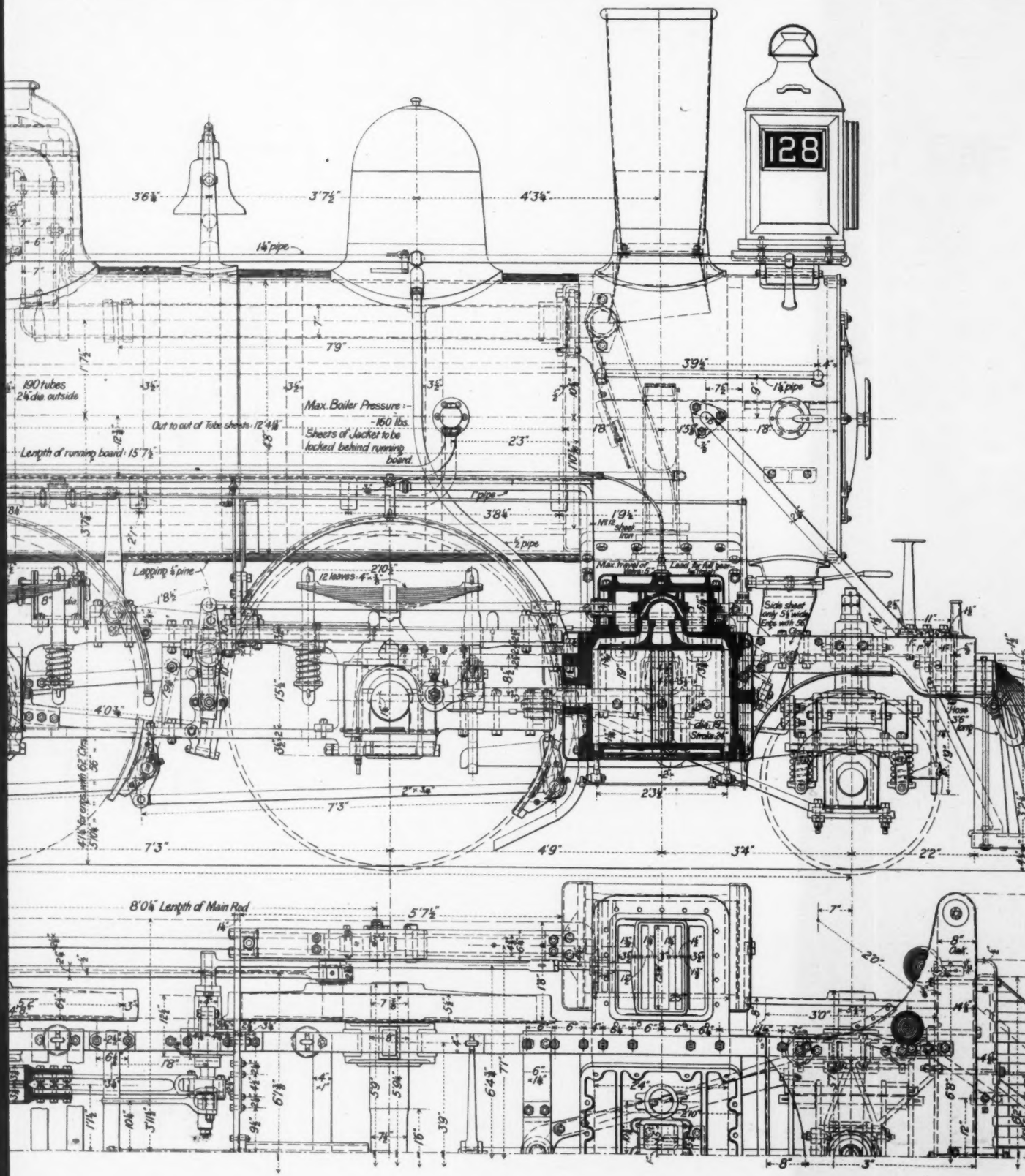
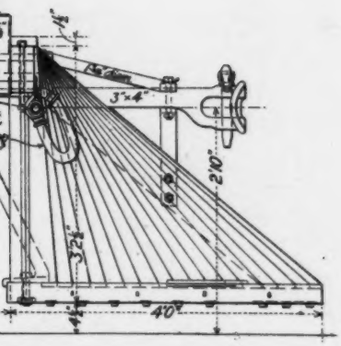
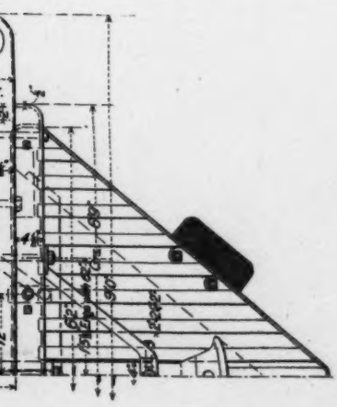
CHICAGO, BURLI


128
190 tubes 2¼ dia outside
Out to out of Tube sheets 12'4⅜"
Length of running board 15'7½"
Max. Boiler Pressure 160 lbs.
Sheets of Jacket to be locked behind running board
Lapping ¼ pine
12 leaves 4"
Side sheet lamp 5½ wide Cips with 58 on Circle
dia. 19" Stroke 24"
8'0¼" Length of Main Rod

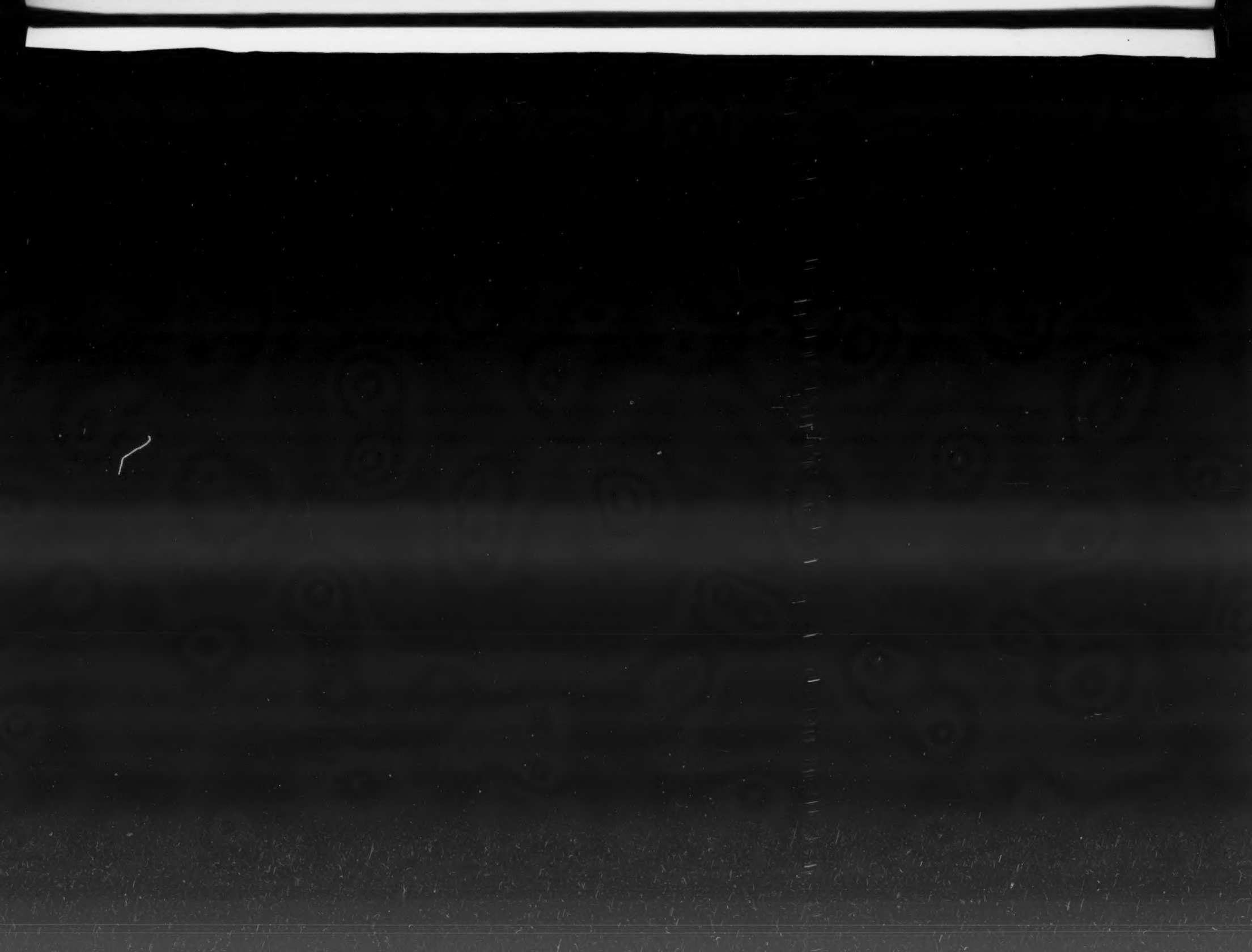
CLASS "H" LOCOMOTIVE.

AGO, BURLINGTON & QUINCY RAILROAD.





CHAS. HART & SONS, LITH., 99 VESEY ST., N.Y.



Compound Locomotives.

It may be fairly said that the most complete and creditable committee report by far at the late Master Mechanics' Convention was that on compound locomotives, reprinted in full in another column. Although signed by a committee of four, it is an open secret that the chairman of the committee, Mr. J. DAVIS BARNETT, did the hard work of preparing the report, although the names of the other three members of the committee, all of them being strong and well known men, will add further weight to it. The report is in form a model of what such a report should be, giving a broad yet careful résumé of the entire question under eight different heads. Mr. BARNETT has, in years past, added greatly to the value of the association's proceedings by other careful reports of this kind, including especially one on boiler practice, presented three or four years ago, which was and is yet, we believe, by far the best single article on the subject.

The report now before us, if not deserving quite such high praise as this, is a thoroughly good one. Taking up its main points in order, the conclusions expressed are as follows:

The committee very decidedly and justly point out that, while it is a great advantage of the compound engine that it permits of the use of higher initial pressures, it is by no means an essential condition. Economies of from 13 to 18 per cent. have been shown with unaltered pressures. At the same time, it is most unlikely that compound engines will use as low pressures as simple ones, except in cases of conversion, when the boiler is not considered strong enough to stand higher pressures, since it sacrifices some of their most important advantages.

The possible gains and losses from compounding are very fully summarized, but this is now familiar ground. The question now is of the amount rather than the existence of the various gains and losses. One prevalent delusion, however, we are glad to see the committee quietly sit down on, viz.: that throttling is in itself and under all conditions a wasteful and unadvisable thing. Much nonsense has been written on the evil effects of this practice. Throttling is merely, in effect, working with a lower boiler pressure, and involves just the same theoretical loss of a less range of expansion, with just the same contravening practical gain, viz.: that it decreases the range of temperature in the cylinder. For this reason throttling is much more economical than an over short cut-off, and its only disadvantage within certain reasonable limits is (or would be, if it were ever permitted to exist when it was doing harm) that it decreases the maximum pressure on the piston. The average runner may be trusted, however, to open his throttle quite as widely as he needs to start his train, and after that experience seems to indicate that it is quite as economical to throttle as it is to cut off much below half stroke, or certainly one-third stroke.

The details given as to the increased cost of compounding are especially practical and to the point. The committee point out, as we have often done, that the difference is really a trifling matter, as respects the simpler types of compounding; but they add a statement which somewhat surprises us, that "the cost of changing simple to two-cylinder compound engines need not exceed $250 to $300 each, if the expense of drawings, patterns and templets be divided over a number of engines." We know that the Pennsylvania and other companies have in contemplation plans for changing a large number of their engines to compound, but we should think it would inevitably cost more than this to do so. The committee figure the fuel saving at $225 to $600 per year, and if the first cost of a change to compound be not more than this it will not be surprising if we should shortly see almost a stampede in that direction.

The committee indulge in a little satire as to the so-called "American conditions" for working, and perhaps do not attach enough importance to the real and great difference which exists in respect to the demand for great starting power and for hauling maximum loads. As respects two-cylinder and four-cylinder compounds, the starting difficulty is non-existent, since they can use live steam for starting; but we think the committee fall into a serious error in what they say as to the Webb type. They say:

> The Webb type of three-cylinder engine, except with the low-pressure crank dead on center, has cylinder power enough to slip both pairs of wheels, and no higher starting power is desirable.

This is certainly wrong in theory, and we think it is in fact. Imagine an ordinary four-driver locomotive to have its wheels made loose on the axle, but coupled in pairs longitudinally as now. Undeniably the engine would still have "cylinder power enough to slip both pairs of drivers," for its cylinder power in relation to the drivers would not be altered; but would the committee maintain for a moment that its starting power remained just the same, or that "no higher starting power was desirable" than still remained to it? Beyond question its starting power would be very gravely diminished, because first one cylinder and then the other would be doing its maximum work, and instead of having the friction of all four wheels to continuously resist slipping, there would be only two wheels. The Webb engine is in precisely this position, except that the four driving wheels are paired transversely instead of longitudinally. The wheels not being coupled, it is very much easier for either the high pressure or the low pressure cylinders to slip their respective drivers, and after one has slipped the slipping of the other is almost sure to follow. Were the wheels coupled the danger of slipping would be much diminished, but one of the great advantages claimed for the Webb type would disappear.

We are surprised to see so loose a statement as that quoted is so otherwise excellent a report. As a matter of fact, the Webb engine tested on the Pennsylvania R. R. did actually prove seriously defective in this very respect, as it has also done in England, although there the difficulty is one of much less moment owing to the lighter trains run, and is claimed not to be serious one.

The committee make a good deal of Mr. URQUHART'S experience in Russia with engines burning crude petroleum, as is but natural, he having done some most admirable experimental and practical work in that country, and having now had a large experience; but it is a fact to be borne in mind that with so readily controllable a fuel as petroleum results may be quite different from what they would be with coal. There can be no doubt of the superiority of petroleum as a fuel, if only the supply were adequate; and, could an unlimited supply of petroleum be counted on at present prices, it would not be many years before all the passenger locomotives, at least in America, would be running with petroleum as fuel. Perfect success in burning petroleum has been attained on the Pennsylvania and other roads; but the trouble is that the Pennsylvania road alone would require some 26,000 bbls. of oil daily to make good the 8,000 tons of coal now used, and this would mean using about half the total yearly oil product of the United States to supply one road. Under such conditions, there is not much use in talking of or considering the use of petroleum as a locomotive fuel, and all petroleum experience must be looked on with some suspicion. It is difficult to see, however, why the benefits of compounding should not be even greater with coal as a fuel than with petroleum, especially in this country, where so large a part of the fuel supply is unquestionably blown unconsumed out of the chimney in order to get the utmost possible hauling power out of the locomotive. Diminishing by 15 or 20 per cent. the demand for steam to do this work (which is limited by the adhesion, not the steam supply) ought surely to mean a still greater economy of fuel, owing to the corresponding decrease in the intensity of the draft, which now tears the fires to pieces.

It is for passenger service, however, that the compound engine seems to be most alluring, although it is possible that it is not really its most important field. Passenger engines fail through lack of steam power rather than lack of adhesion, and anything, therefore, which decreases the demand for steam for given work increases their hauling power or possible speed, and so is more directly beneficial than it is with freight engines, since it increases the work which one engine can do, which is a far more important gain than simply to decrease by a small percentage the cost of doing a given quantity of work.

Putting the whole case for compound engines broadly, it stands thus: The work of an engine is limited by the weakest of these three forces: the adhesion or tractive power, the boiler or steaming power, the machinery or converting power. The last may be made anything which the designer wishes, so that no well-designed engine will ever fail from any but deficiency in one or the other of the first two forces. A well-designed freight engine, in this country at least, never fails from lack of steam power in regular service, for the reason that it is expressly designed to haul the utmost load which its adhesion will permit, and high speed is not important to it. Therefore, as no compounding which does not increase weight can add to the hauling power of a freight locomotive, the only good which compounding can ever do for them is to save 15 to 20 per cent. of fuel charge, which averages about 10 per cent. of total operating expenses, or, say, 1 to 2 cts. per train-mile. This saving is an important but not a vital one. If compounding could add 10 per cent. to hauling capacity, it would save over 5 per cent. of the *total* expenses per train mile, or, say, 4 or 5 cts.

For passenger service something like this is possible. Passenger engines of good design have more than ample adhesion (except sometimes in starting) and fail only from lack of steam power. Therefore, anything which makes the same steam go 20 per cent. further adds about 20 per cent. to the hauling power of an engine at any given speed, or to the possible speed with any given train; and, moreover, on these considerable stretches of any road where the maximum power is not required the compounding is making the same saving in the total cost of fuel as it makes with freight engines. Passenger service is therefore very naturally the first field for efforts to establish compounding, although, as we have said, in the end the compounding of freight engines may become the most important, owing to their greater number, and to the growing tendency to run freight fast, which will become still stronger when automatic brakes and couplers are in universal use.

The Present Status of the Water-Works Interest of the United States and Canada.

We present herewith some data from the forthcoming MANUAL OF AMERICAN WATER-WORKS. The issue for 1889-90 includes descriptions of 2,047 works, 1,960 of which are in the United States, 83 in Canada and four in Newfoundland. Of these, 77 in the United States and three in Canada, or 80 in all, are subsidiary works; that is, take their water supply from some other plant, but are otherwise independent. Several plants extend throughout two or more villages or cities, this being especially true in Maine, Rhode Island and New Jersey. A few towns have duplicate plants, but these are not common, and are far less in number than the duplicate gas and electric lighting plants in this country.

The recent comparative growth of the water-

TABLE 1—S.

UNITED STATES AND CANADIAN WATER-WORKS—SUMMARY OF DATES OF CONSTRUCTION BY GROUPS OF STATES.

[Date of completion taken when construction extended over more than one year.]

WATER-WORKS BUILT.

Year.	N.E.	Mid.	S. Atl.	So. C.	N. C.	N. W.	S. W.	Pac.	Total U. S.	Canada.
B'fore 1800	1	3	1	..	..	..	..	..	5	..
1800-10	3	6	..	..	..	..	..	..	9	1
1810-20	2	1	..	..	1	..	..	..	4	..
1821-30	1	5	3	1	1	..	1	1	13	..
1831-40	3	3	3	6	3	..	..	1	19	1
1841-50	3	12	1	1	2	..	..	..	19	4
1851	1	3	..	..	..	..	..	..	4	
1852	1	4	..	..	..	..	..	..	5	
1853	..	2	..	..	..	..	..	2	4	1
1854	(1) 2	3	1	..	..	..	..	..	(1) 6	..
1855	4	2	..	..	..	..	..	..	6	..
1856	1	3	1	..	1	..	..	..	6	1
1857	2	(1) 5	..	..	..	..	..	1	(1) 8	..
1858	..	2	2	..	..	..	..	1	5	..
1859	1	5	..	..	..	..	..	2	8	1
1860	(1) 2	4	..	1	2	..	..		(1) 9	1
1861	1	3	..	..	..	..	..	1	.. 5	..
1862	3	..	..	..	1	..	..	3	.. 7	..
1863	..	..	..	..	..	..	..	..	.. ..	1
1864	1	1	..	1	..	..	..	1	.. 4	..
1865	1	2	..	..	..	..	..	5	.. 8	..
1866	2	3	..	..	1	..	..	2	8	
1867	(1) 2	5	..	1	..	1	..	1	(1) 10	
1868	(1) 4	6	..	1	2	..	..	2	(1) 15	
1869	(1) 9	4	..	.	5	..	..	2	(1) 20	
1870	(3) 5	10	..	1	9	2	.	2	(3) 29	1
1871	(1) 2	16	1	..	6	2	1	7	(1) 35	
1872	8	13	1	2	8	..	1	1	34	1
1873	15	12	1	2	13	..	1	5	49	3
1874	7	(1) 12	1	..	9	2	1	6	(1) 38	2
1875	9	(2) 14	2	..	9	2	3	4	(2) 43	2
1876	(1) 10	(1) 13	2	1	11	(1) 5	1	5	(3) 48	3
1877	3	(1) 4	1	..	4	1	..	(1) 2	(2) 15	1
1878	(1) 6	11	2	..	(1) 4	4	2	(1) 2	(3) 31	2
1879	(1) 9	14	..	2	10	3	6	(1) 1	(2) 45	2
1880	(1) 6	9	2	1	6	4	5	5	(1) 38	(1) 2
1881	(1) 8	10	2	1	7	6	4	2	(1) 40	3
1882	(3) 9	(6) 14	4	1	(1) 22	13	9	9	(10) 81	5
1883	(1) 9	(3) 23	2	2	16	19	14	4	(4) 89	4
1884	(1) 22	(3) 24	1	1	18	20	17	7	(4) 110	(1) 4
1885	(3) 18	(1) 28	5	1	26	9	12	4	(4) 103	
1886	(2) 19	(2) 32	7	6	(1) 37	25	11	5	(5) 142	5
1887	(7) 25	(1) 37	8	5	(1) 22	39	15	13	(9) 174	7
1888	(2) 23	(4) 37	18	18	66	63	(1) 32	27	(7) 284	(1) 12
1889	19	39 (1)	16 (1)	12	38	(1) 38	10	22	(5) 194	7
Unkn'n	(1) 9	(3) 19	3	2	3	8	5	5	(4) 54	7
Totals	(34) 291	(31) 478	(1) 91	(1) 70	(4) 373	(2) 266	(1) 151	(3) 163	(77) 1,883	(3) 84

Subsidiary water-works, viz.: those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems, are enumerated above in perentheses.

Canada in this and the following tables includes 4 Newfoundland works.

works industry in different sections is shown below by groups of States. The period covered is about 14 months, but the dates must be understood to be only approximate, as it is practically impossible to say how many water-works were actually completed in so large a territory on a given day. As showing the comparative growth in the different groups, however, the following figures are fairly correct:

Close of	N. E.	Mid.	So. Atl.	So. C.	No. C.
1888	304	463	74	57	338
1889	325	509	92	71	377
Increase	21	46	18	14	39
P. C. of Inc.	6.9	9.9	24.3	24.6	11.5

	N. W.	S. W.	Pac.	Total U. S.	Canada.
1888	229	141	143	1,749	76
1889	268	152	166	1,960	87
Increase	39	11	23	211	11
P. C. of Inc.	17	7.8	16.1	12.1	14.5

The relative increase will be most quickly grasped by examining the percentages ranged by groups in a descending scale:

South Central	24.6	Total United States	12.1
South Atlantic	24 3	North Central	11.5
Northwestern	17	Middle	9.9
Pacific	16.1	Southwestern	7.8
Canada	14.5	New England	6.9

The sections of the country showing greatest increase are those which until recently have been backward in water-works construction, while New England and the Middle States, with but slight increase, have for some time had a large number of works. The small gain in the Southwestern group can be understood when it is remembered that the States included are Missouri, Arkansas, Texas and Colorado, with Indian and New Mexico Territories. The territories are extremely backward and the States are at present rather slow in their development, except in limited parts of their areas. Besides this, the larger towns have been quite generally supplied for a few years, and the growth for the last 20 years is quite as marked as in any section of the country, the number increasing from one in 1870 to 22 in 1880, and from the last number to 152 in 1889. In Colorado and slightly in Texas irrigating companies make accessible to many of the smaller towns a supply of running water near at hand so that it is not necessary to pipe it to the houses. If this is an effective cause in retarding the growth of water-works built wholly for domestic supply, it applies equally to the Northwestern and Pacific groups, and to their advantage, as notwithstanding this they have made great gains in numbers.

The growth of the water-works interest from the start is shown in detail by tables 1 to 3-S. Table 1-S gives the number of works built in each group prior to 1800. and in each decade since then to 1850, then by years to the present time. Table 2-S gives the same for decades to 1850 and for half decades since, and Table 3-S shows the total number of works in each group at the close of each decade.

It will be seen by examining Table 1-S that there were in 1800 five works in the United States, all in the first three groups, and that each decade to 1850, and each year thereafter, excepting 1863, has given an increase to the number. The total number of works built during the war period, 1861-5, was but 24, or only two-thirds as many as were built in the preceding five years, while in one of the war years, 1863, water-works construction was entirely suspended.

In the South Atlantic States from 1859 to 1870 inclusive, 12 years, not a single water-works was built. In the Northwestern group the first plant was constructed in 1867, while in the Southwestern States, save one, between 1821 and 1830, not a single plant was built until 1871. The marvellous growth in this section since 1871 has been commented on above.

The number of works in Canada at the end of each decade is shown in more detail by provinces as follows:

	At the end of—					In
	1850.	1860.	1870.	1880.	1885.	1889.
In Ontario	2	4	5	14	21	41
Quebec	1	2	2	10	14	19
Manitoba	..	..	..	..	1	1
British Columbia	..	..	..	..	.	4
New Brunswick	1	2	2	3	5	6
Nova Scotia	1	1	1	2	4	11
Prince Edw. Isl'd	..	..	..	..	..	1
Total, Dominion of Canada	5	9	10	29	45	83
Newfoundland	1	1	2	2	3	4

Perhaps the most interesting of these three tables is the last one, 3-S, which shows the number of works in each group and in Canada, and the total in the United States at the end of each decade. The increase and percentage of increase in each decade, including subsidiary works, for the United States and Canada is:

Decade closing in	No in U. S.	Inc.	P. C. of Inc.	No. in Canada.	Inc.	P. C. of Inc.
1800	5					
1810	14	9	180	1		
1820	18	4	29	1	0	0
1830	31	13	72	1	0	0
1840	50	19	61	2	1	100
1850	69	19	38	6	4	200
1860	133	64	93	10	4	67
1870	245	112	84	12	2	20
1880	636	391	160	31	19	158
1889	1,960	1,324	208	87	46	150

These figures need no comment. The remarkable growth of the water-works interest is very graphically shown by means of a colored diagram, and in connection with that of railways, in ENGINEERING NEWS for April 27, 1889.

While modes of supply vary largely with local or sectional conditions there is considerable latitude for choice in this respect. Table 4-S shows the number of gravity and pumping works in each group, and the number where the mode of supply is unknown, with the percentage each of to the total. The New England and Pacific States have almost exactly the same percentage of gravity works, 52 and 52.2 per cent, respectively, and the North Central States with 4.5 per cent, and the South Central with 8.4 per cent have the smallest percentage. Some works have two or more systems, and of course the subsidiary works are not included in the table. In the MANUAL for 1888 the pumping works are summarized in more detail, the number and precentages of works pumping to tanks, stand-pipes, reservoirs and direct being given.

One of the most earnestly discussed questions of the day is whether natural monopolies should be owned and controlled by public or private corporations. Among these natural monopolies are gas and electric lighting plants, street railways and water-works. So far as we are aware, there are in the United States or in Canada no street railways owned by municipalities. There are in the United States at least three and probably four or five gas works owned and operated by municipalities out of a total of about 1,000 plants. Of some 1,300 or more electric lighting plants in this country, at least 50 are owned by the city in which they are located. When we consider water-works we see a far different state of affairs, as is shown in Table 5-S. From this table it appears that of the 1,960 water-works in the United States 818, or 41.7 per cent., are owned by public corporations, and 1,106, or 56.4 per cent., by private corporations, the ownership of the remaining number being unknown. In Canada the showing for public works is still better, there being 57.1 per cent. public to 41.7 per cent. private, 1.2 per cent. of the total number being of unknown ownership. If we take sections of the country we find a wide difference, the North Central group of States having 64.7 per cent.; the Northwestern, 56 per cent., and the Pacific States but 15.7 per cent. of public works.

The number of public and private works in each State, and the population on each class of works, was given in the MANUAL for 1888. It may be said here that in some States the ownership is almost wholly public, in others private, and that the larger cities are supplied by public works, only about one-third of the population on water-works depending upon private companies for their supply.

Perhaps the most accurate index of the growth of water-works in the past year is the increase in the miles of water mains. This is shown for each State and group of states by Table 6-S. The first column gives the mileage at the close of 1888, as shown in our last summary, but as this did not include those works described in the Supplement to the 1888 MANUAL, nor a few works built in or prior to 1888, but not reported soon enough for description until the present issue, it has been necessary to correct the previous mileage by means of columns two and three. It should be noted that the fourth column gives the extensions to old, and the fifth the mileage of new works. Further than this the table needs no explanation.

New York, Massachusetts and Pennsylvania have the largest mileage, viz.: 3,549.39, 3,336.67 and 3,135.41, or together, more than 10,000 miles, which is over one-third the total mileage in the United States. The smallest mileage is in Idaho Territory, 15, and the smallest in the States is in North Dakota, 44, while South Carolina has but 47 miles of mains.

TABLE 2—S.

UNITED STATES AND CANADIAN WATER-WORKS—SUMMARY OF CONSTRUCTION BY GROUPS OF STATES, DECADES AND HALF DECADES.

[Date given is that of completion of works.]

Date.	N.E.	Mid.	S. Atl.	S. C.	N. C.	N. W.	S. W.	Pac.	Total U. S.	Canada.
B'fore 1800	1	3	1	..	..	..	..	..	5	..
1800-10..	3	6	..	..	.	..	..	..	9	1
1811-20..	2	1	..	..	1	..	.	..	4	..
1821-30..	1	5	3	1	1	..	1	1	13	..
1831-40..	3	3	3	6	3	..	..	1	19	1
1841-50..	3	12	1	1	2	.	..	..	19	4
1851-55.. (1)	8	14	1	..	..	..	..	2 (1)	25	1
1856-60.. (1)	6 (1)	19	3	1	3	..	..	4 (2)	36	3
1861-65..	6	6	..	1	1	..	..	10	24	1
1866-70.. (6)	22	28	..	3	17	3	.	9 (6)	82	1
1871-75.. (1)	41 (3)	67	6	4	45	6	7	23 (4)	199	8
1876-80.. (4)	34 (2)	51	7	4 (1)	35 (1)	17	14	(3) 15 (11)	177	(1) 10
1881-85.. (9)	66 (13)	99	14	6 (1)	89	67	56	26 (23)	423	(1) 16
1886- 9.. (11)	86 (9)	145	(1) 49	(1) 41 (2)	173	(1) 165	(1) 68	67 (26)	794	(1) 31
Unk'wn (1)	9 (3)	19	3	2	3	8	5	5 (4)	54	7
	(34) 291 (31)	478	(1) 91	(1) 70 (4)	373	(2) 266	(1) 151	(3) 163	(77) 1,883	(3) 84

TABLE 3—S.

UNITED STATES AND CANADIAN WATER-WORKS—NUMBER OF WORKS BY GROUPS OF STATES AT THE END OF EACH DECADE.

1800.	1	3	1	..	..	..	..	..	5	..
1810.	4	9	1	..	..	..	.	..	14	1
1820.	6	10	1	..	1	..	..	..	18	1
1830.	7	15	4	1	2	..	1	1	31	1
1840.	10	18	7	7	5	..	1	2	50	2
18*0.	13	30	8	8	7	..	1	2	69	6
1860. (2)	27 (1)	63	12	9	10	..	1	8 (3)	130	10
1870. (8)	55 (1)	97	12	13	28	3	1	27 (9)	236	12
1880. (13)	130 (6)	215	25	21 (1)	108 (1)	26	22	(3) 65 (24)	612	(1) 30
1889. (34)	291 (31)	478	(1) 91	(1) 70 (4)	373	(2) 266	(1) 151	(3) 163	(77) 1,883	(3) 84

TABLE 4—S.

UNITED STATES AND CANADIAN WATER-WORKS—MODE OF SUPPLY.

	Gravity. Number.	Gravity. P. c. of Total.	Pumping. Number.	Pumping. P. c. of Total.	Unknown. Number.	Unknown. P. c. of Total.	Total.
New England	154	52	135	45.6	7	2.4	296
Middle	197	41.5	267	56.4	10	2.1	474
So. Atlantic	17	18.5	71	77.2	4	4.3	92
So. Central	6	8.4	60	84.5	5	7.1	71
No. Central.	17	4.5	356	93.9	6	1.6	379
North western	27	10.1	236	88.4	4	1.5	267
Southwestern	33	20.6	125	78.1	2	1.3	160
Pacific	94	52.2	82	45.6	4	2.2	180
Total U. S.	545	28.4	1,332	69.4	42	2.2	1,919
Canada	32	36.4	53	60.2	3	3.4	88

TABLE 5—S.

UNITED STATES AND CANADIAN WATER-WORKS—OWNERSHIP.

	N. E.	Mid.	So. Atl.	So. C.	No. C.	N. W.	S. W.	Pac.	Total U. S.	Canada.
Public.	133	154	47	13	244	150	51	26	818	48
Private.	191	323	45	58	131	118	100	140	1,106	35
Unknown.	1	32	..	..	2	...	1	...	36	1
Total.	325	509	92	71	377	268	152	166	1,960	84
Percentage of each to total.										
P. c. of Pub.	40.9	30.3	51.1	18.3	64.7	56	33.5	15.7	41.7	57.1
P. c. of Priv.	58.8	63 4	48.9	81.7	34 8	44	65.8	84 3	56 4	41.7
P.c.of Unk'n.	.3	6.3	....	....	.5	..	.7	....	1.9	1.2

TABLE 6—S.

UNITED STATES AND CANADIAN WATER-WORKS—MILES OF MAINS BY STATES AND GROUPS OF STATES.

State.	1888 record.	Add.	Extensions Actual, 1888.	Extensions to old works.	New works.	Total, 1889.	Inc. in 1889.
Maine	506.95	8	513.95	23.02	24	560 97	47.02
New Hampshire	327 21	10	337.21	71.27	9	417.48	80.27
Vermont	176.01	2.5	185.51	22.09	7.5	215.1	29.59
Massachusetts	3,077.78	16	3,088.78	187.89	60	3,336.67	247.89
Rhode Island	443.35	..	443.35	35.49	...	478.84	35.49
Connecticut	765.4	18.1	783.5	55.19	25.9	864.59	81.09
New England Group	5,290.7	61.6	5,352.3	394.95	126.4	5,873.65	521.35
New York	3,226.54	64.2	3,290.74	154.85	103.8	3,549.39	258.65
New Jersey	1,032.87	25.5	1,058.37	107.66	34	1,20 .03	141.66
Pennsylvania	2,471.37	74.25	2,545.62	521.04	68.75	3,135.41	589.79
Delaware	84 75	2	86.75	2.34	3	92.09	5.34
Maryland	484.5	...	484.5	4.5	2	491	6.5
District of Columbia	128	...	128	58	...	186	58
Middle Group	7,428.03	165.95	7,593.98	848.39	211.55	8,653.92	1,059.94
Virginia	298.05	....	298.05	23.81	25.25	347.11	49.06
West Virginia	96	3	99	11.5	....	110.5	11.5
North Carolina	95.55	0.25	95.8	4.68 [1]	7.5	98.62	2.82
South Carolina	36.35	.	36.35	10.65	. .	47	10.65
Georgia	162 75	8	170.75	26.88	8	205.63	34.88
Florida	58.45	....	58.45	13.6	.....	72.05	13.6
South Atlantic Group	747 15	11.25	758.4	81.76	40.75	880.91	122.51
Alabama	240.5	....	240.5	32.1	38	310.6	70.1
Mississippi	32.3	0.75	33.05	2.45	21	56.5	23.45
Louisiana	86.5	....	86.5	3.5	..	90	3.5
Tennessee	202.5	....	202.5	24.95	5.5	232.95	30.45
Kentucky	314.25	....	314.25	13.65	12.25	340.15	25.9
So. Central Group	876.05	0.75	876.80	76.65	76.75	1,030.2	153.4
Ohio	1,447.46	21	1,468.46	166.21	55.24	1,689.91	221.45
Indiana	528.15	3	531.15	12 88	10	554.03	22.88
Michigan	967.25	14.25	981.5	94.24	98	1,173.74	192.24
Illinois	1,576.07	1.5	1,577.57	89.99	22.5	1,690.06	112.49
Wisconsin	517 82	.....	517.82	36.31	17.85	571.98	54.16
North Central Group	5,036 75	39.75	5,076.5	399.63	203.59	5,679.72	603.22
Iowa	352	1.75	353.75	68.93	17.75	440.43	86.68
Minnesota	345	....	345	39.72	45.65	430.37	85.37
Kansas	311	.....	311	195 32	21.33	527.65	216.65
Nebraska	247	2.5	249.5	49.22	17.45	316.17	66.67
South Dakota	56	3.8	59.8	1.13	9	69.93	10.13
North Dakota	36	.....	36	6 15	2	44.15	8.15
Wyoming	44	... .	44	37	...	81	37
Montana	47	.....	47	1.75	17.75	66 5	19.5
North Western Group	1,438	8.05	1,446.05	399.22	130.93	1,976.2	530.15
Missouri	645	12.5	657.5	44.8	. .	702.30	44.8
Arkansas	64	0.5	64.5	15.2	2	81.7	17.2
Texas	465	5.5	470.5	33.63	35	539.13	68.63
Colorado	270	.....	270	60.58	25.3	355.88	85.88
New Mexico	54	2	56	.5	.....	56.5	.5
South Western Group	1,498	20.5	1,518.5	154.71	62.3	1,735.51	217.01
Washington	66	28	94	34.5	27.1	155.6	61.6
Oregon	115	4	119	6.85	10 5	136.35	17.35
California	1,561	44	1,605	292.88	13.8	1,911 68	306.68
Arizona	19	.....	19	17.5	.....	36.5	17.5
Nevada	127	.....	127	3.7	.....	130.7	3.7
Utah	43	.....	43	4.18	5.5	52.68	9.68
Idaho	11	.....	11	1	3	15	4
Pac. Group	1,942	76	2,018	360.61	59.9	2,438.51	420.51
Total United States	24,257	383.85	24,640.53	2,715.92	912.17	28,268.62	3,628.09
New Brunswick	92.75	..	92.75	3.2	....	95.95	3.2
Nova Scotia	110	..	110	4.5	18.75	133.25	23.25
Prince Edward Island	15.25	..	15.25	....	....	15.25	....
Newfoundland	29	..	29	4	...	25	4
Quebec	308.05	8	316.05	20.95	....	337	20.95
Ontario	583.35	15	598.35	22.26	26.5	647.11	48.76
Manitoba	20	..	20	....	....	20	....
British Columbia	25	17	42	16.5	....	58.5	16.5
Total Canada	1,183.4	40	1,223.4	71.41	45.25	1,372.06	116.09

[1] [The apparent decrease in the mileage of old works in N. C. is due to the fact that two works reported a total of 9 miles less for the 1889-90 than for 1889 MANUAL, and the discrepancy was not discovered in time to write for an explanation.]

Considering increase in total mileage we find Pennsylvania, California and New York at the head, with 589.79, 306.68 and 258 miles of increase, respectively. The smallest increase shown in the United States is in New Mexico, one-half of a mile.

The totals for the various groups will be found in their proper place in Table 6. As would be expected, the Middle States have the greatest mileage, 8,653.92, and the South Atlantic the least, 880.91 miles.

The percentages of increase in total mileage for each group are:

N. E.	Mid.	So. Atl.	So. C.	No. C.
9.73	13.96	16.23	17.46	11.87
N. W.	**S. W.**	**Pac.**	**U. S.**	**Canada.**
36.65	14.29	20.86	14.72	9.57

New England stands at the foot, as it did in percentage of increase in number of works built in 1880, while the largest increase is in the northwestern group, which ranked third in percentage of increase of new works.

As the results of the eleventh census are not available at this writing, it has not seemed best to make any studies involving the use of populations, although both the last census, and the estimated population of each city or village mentioned are given in the MANUAL for 1889-90. An exhaustive study of the data presented in the MANUAL for 1888, in connection with populations, was presented in the introduction to that volume, together with other summaries which are not included this year.

Further data from the forthcoming MANUAL will appear in these columns next week, and probably in immediately succeeding issues.

CORRESPONDENCE.

Good Books on Highway Construction.

FORDHAM, N. Y., June 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

Will you please inform me in your next issue where I can get a good work on telford and macadam road making, and maintenance of same? Yours, etc., J. B. SHEA.

[We refer our correspondent to a notice of an excellent work on "Pavements and Roads," just issued by *The Engineering and Building Record*, published on page 585 of this journal. It is a book which we can recommend most heartily. This company has a book in the bindery entitled "Road Making and Maintenance," which will be issued in about two weeks. It is made up on the prize essay of CLEMENS HERSCHEL on "The Science of Road Making," and the paper by E. P. NORTH on the "Construction and Maintenance of Roads," which together contain about the best practice on highway building and maintenance. The book will be handsomely bound in cloth, and the price will be $1.50.—ED. ENG. NEWS.]

The Fairmount Gravity Railroads.

LYNCHBURG, Va., June 23, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of June 21, 1890, you illustrated the proposed gravity railroad in Fairmount Park, Philadelphia; but you give a most gratuitous advertisement to *one* of a noted firm of civil engineers, and give no credit to the party who actually did the work. The firm of Wilson Bros. & Co. were the engineers, practically, consulting, and chief; but if there was an individual entitled to that rank it was not Mr. DARRACH. I claim *all* the credit for locating the line, making up the estimates, maps, and profile, excepting such few revisions as were suggested by Mr. SMEDLEY.

While I do not arrogate to myself the title of Chief Engineer, I claim that Mr. DARRACH goes too far in putting his name on my work as Chief Engineer, when I was perfectly satisfied to rest incog. with the firm name of Wilson Bros. & Co. as Chief Engineers. U. S. LUTZ.

Electric Light Candle Power.

TOPEKA, Kans., May 28, 1890.

TO THE EDITOR OF ENGINEERING NEWS.

SIR: Would you kindly give through your columns some information in regard to the standard candle power, as used in this country to measure the power of electric lights? The city of Topeka has a plant with three 75 H. P. engines, lighting 184 arc lamps. In February of this year, after many complaints as to the amount of light furnished, the city employed an expert to measure the candle power. In his report he says: "There is a rule of thumb in general application in the United States which is to the effect that a nominal 2,000 C. P. arc lamp, taken at a point 45° from perpendicular, should require 450 watts of electrical energy, provided the electromotive force is greater than 20 volts."

By this rule one watt of electrical energy would give 4.44 C. P., and by his test of 17 lamps the average of each lamp would be 2,013 C. P. I find, taking Gordon Wigan, A. M., as authority, in his work by Cassell & Co. in 1884:

On page 40, one volt multiplied by one ampère = one watt.

On page 52, one carcel = 9.5 English standard candles.

On page 160, one H. P. = 128 carcels.

On page 40, one H. P. = 746 watts.

So that: One watt = 1.63 C. P.

And using this as a standard, our 17 lamps would average 737 C. P. instead of 2,013, as by the rule of thumb adopted by nearly all of the American arc light companies. The same lights, tested by a photometer, do not indicate much more than 500 C. P.

I understand that the incandescent light companies measure their candle power by the photometer, and that they furnish the light that they stipulate. The arc lights seemingly do not. In Wigan's work, page 267, a series of tests made in 1881 at the Paris Electrical Exhibition show that the Brush lamps are of 78 carcel power, or equal to 741 candle power.

This seems to be a simple matter, and I see no reason for inventing a new kind of arithmetic so as to accommodate the arc light companies.

Further light upon this subject will greatly oblige

LEWIS KINGMAN.

[Our correspondent has given us more information in his letter than we can give him; but his complaint seems to be a general one. It seems to be generally admitted and understood that the arc lights are rated at three or four times the candle-power which they will show when actually tested, the excuse being (as we understand it) that the light is so generated as to be thrown chiefly downward, and so is actually far more efficient for the purposes required than its actual comparative candle power would indicate. Purely commercial motives have probably more to do, however, with the undeniable exaggeration of candle power which is common in rating arc lights; 2,000 C. P. sounds much better than 700 C. P., and with the ordinary apparatus it is not possible to measure either.—ED. ENG. NEWS.]

The Swinerton Polygonal Driving Wheel.

BOSTON, Mass., June 13, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: While I am greatly obliged to you for the extended record of tests of my invention, occupying much more space in your valuable and interesting journal ("the ablest of its kind in this country," so said a prominent publisher to me not long since) in your issue of May 24 than its importance demands; yet, as there are a number of statements in this article which I consider so manifestly unjust and unfair toward us, under the circumstances of the case, that I feel compelled to solicit space in your columns for a reply.

You can imagine my surprise and disappointment, upon reading your article, to find a strong bias, not to say prejudice, against "the wheel" pervading it throughout, while the evidence that I submitted appeared to have but very little weight. In your second paragraph, as if to put your readers on guard against forming any favorable impression of the wheel, you state, "we have no confidence in the polygonal wheel or in the advantages claimed to be derived from its use."

Then follow long quotations from a pamphlet that we issued more than two years ago in the early days of our experiments. Now, if it had been your object to present facts regarding the experiments made with "the wheel" it would seem that you should have published the statements of the six Boston & Maine experienced engineers who had run different locomotives equipped with polygonal wheels, which you had in your possession. Those statements are the results of actual service, some of long experience with "the wheels," and they testify unequivocally to the superiority of the polygonal as compared with round wheels.

Then, too, Mr. FURBER's endorsement of Mr. SMITH's statement respecting the six months' run of the *Onward* on the Portland express, it seems to me, should have been considered worthy of a passing notice, to say the least.

It reads as follows and is appended to Mr. SMITH'S report: "I endorse the above and should be pleased to see the locomotive *Onward* tried on other roads. The *increased traction developed* by this locomotive is her strong point." (Signed) JAS. T. FURBER,

Gen. Man. B. & M. R. R.

The article makes a point, and is entitled to it, in quoting from our pamphlet, "the cylindrical wheel which depends for its traction upon a mathematical line," and then saying, "the latter part of the above paragraph is certainly incorrect, since the actual contact between driving wheels and rails is not a mathematical line (as has been proved by careful tests), but a surface of oval form averaging perhaps ⅛ × ¾ in." I know not who made these tests, but by our tests it is certainly as far from correct as the mathematical line. An area ⅛ × ¾ in. is equal to ⅜ of a square inch or one inch long crosswise of the rail by ⅜ of an inch in width. Now our experiments made by jacking a wheel up and dropping it down upon oiled paper between wheel and rail show a line not exceeding 1-16 in. wide and one inch long on the average.

With regard to slipping of driving wheels, quotations are made from the pamphlet and unfavorable comments made thereon. The most important statement under this head, however, is omitted, viz.: "Very few data can be obtained upon which to form a reliable estimate of this loss."

I suspect it would be very difficult to make tests that would even approximately show the slipping of driving wheels in ordinary everyday work; for the reason that if a counter were attached to an engine to count the revolutions, the engineer would be likely to handle his throttle more carefully than in ordinary work. I have made much inquiry with respect to this subject and have, at length, come to this conclusion: that no man knows how much an engine slips her drivers save him who runs her, and "he won't tell." His instructions are to make the time, and "he gets there if it's in her." That there is a great loss through slipping driving wheels all engineers with whom I have conversed on the subject have admitted. I know not what your authority is for saying that the wheels have not proved a success on the L road, for you do not mention it, but I will give you mine for saying that they have. Get on to engine No. 19, at City Hall, some evening, when the dew is falling or when there is a wet rail; ride to Harlem and back, see her haul the train over those grades (some of them nearly or quite 25) without the use of sand, as I have recently done, talk with the engineer about her performance for the past six months, and you will know more about this subject than you seem to know now.

Moreover, Col. Hain has recently given an order to equip a new engine, now building, with polygonal wheels. Respecting the work done on the Jersey Central, you say "the *Onward* recently hauled the train of four (five was number; I was there and counted them) heavy cars a distance of 30.2 miles with two stops (and three slow-ups over bridges, etc., should have been added) in 43 minutes." This was done more than once, too. If you are desirous of ascertaining the facts in this case, go to Jersey City some fine morning at 11 o'clock, find "Old Bill Aton" (25 years an engineer), who ran the *Onward* on this train, and he will give you much valuable information respecting the increased traction which he observed that her polygonal wheels developed. "A good deal of reliance is placed upon the sand-jet and upon the device for increasing the weight on driving wheels." The former was not in use during any of our work on the B. & M. No reliance whatever was placed upon it; it was put upon the engine on trial, and we do not own it to-day. Precisely how much reliance is placed upon the latter may be seen in Forney's table, showing pulling tests at Lawrence, where it is shown that, with polygonal wheels, it increased the hauling capacity from 859,550 to 967,600 = 108,050; with smooth wheels from 320,500 to 545,570 = 225,070, say you; "while the table above given is on *pretty good* authority," etc., and you saw Mr. Forney's signature to that table and unless this is a forgery it is on first-class authority.

Next we read, "Tests of this kind are of little real value unless carried out extensively," etc. It is hard to say what limit you would place upon the word "extensively" in this case, for it must have a limit somewhere. We have had from one to four locomotives running every day, and some of them nearly every night on the B. & M. system during more than three years, on all kinds of trains, under all conceivable conditions of rail and weather, and if this is not "extensively" we do not comprehend the definition of that term.

The most surprising statement, however, that you make is this, "We have already shown that the claim for increased area of contact between wheel and rail is incorrect." Although I have read your article carefully several times, I fail to find the slightest allusion to our claim for increased area of contact between wheel and rail by use of the polygonal wheel. Possibly you may have attempted to show this elsewhere, in some former issue; if so, I should be pleased to learn how you show that a facet one inch wide on the polygonal wheel will have no larger area of contact with the rail than that which is obtained by the round wheel.

Finally, you end as you began with a bias against the wheel (this I say because you had the evidence of the work done by the wheel). "It certainly does not seem to be designed on a correct mechanical principle." For what reason you do not say, but of one thing I am certain, viz., that I shall not be confronted with the great and inflexible principles that are thought by many to underlie the so-called laws of Gen. MORIN, for during my investigations I have consulted many eminent authorities, not one of whom has given so able and convincing a proof of the fallacy of those so-called laws as has Mr. A. M. Wellington in his great work entitled "Railway Location." Almost every railway mechanic who pretends to any knowledge upon the subject has assailed "the wheel" with the laws of Morin, and why should he not? Does he not find these laws laid down, in nearly every text-book with which he is familiar, as immutable as the ultimate laws of friction? Yet the ablest writers upon mechanics, among whom are Rankine, Buell, Sonnet, Smith, Routh, Hirn, Bochet, Kimball, Thurston, and last, but by no means least, Wellington, pronounce these laws to be unsound. In conclusion, let me say that until some other locomotive of less than 50 tons weight, and with single cylindrical drivers, shall perform the work the *Onward* has done, I think the directors of our company will hold fast to the polygonal wheel. C. E. SWINERTON,

Prest. Swinerton L. D. W. Co.

[We gladly honor Mr. SWINERTON'S heavy draft upon our space that he may have every chance to expose the errors to his injury into which he thinks that we have fallen, but he must excuse us for saying that his tests do not establish his case, for the reason that there is no performance of the polygonal wheel yet reported in definite figures which is in any respect more remarkable than has been repeatedly done with round wheels. Since the appearance of an original article, in which we gave in full the records which seemed to show his great gain in hauling power over round wheels, we have made computations from these records, and we find this: The reported performances of the polygonal wheel were really good, running up to an adhesion of about one-third the weight on drivers, which is as high as (but no higher than) what has been realized repeatedly from round wheels, but can be realized any day from any ordinary locomotive in good order on clean rails. On the other hand, the reported comparative performances of the round-wheel engines were very inferior, far below the true capacity of any ordinary engine, well handled, and we therefore assert with confidence and from certain knowledge that these engines which he compares with his own were either in bad order or incompetently or dishonestly handled. This being so, all comparison of definite records falls to the ground, and Mr. SWINERTON must excuse us for saying that we have seen in our day too many "certificates" to give much weight to them when definite records will not hold water. It is too easy for men to err, and imagination is a powerful factor in all such matters. We have no "bias" in the unfair sense against his polygonal wheel. He has, to our knowledge, interested many able and competent railroad men in it, and no one would take more pleasure than we in seeing him establish his novel claims, nor do more to make known that he had established them; but the man who does not feel a "bias" in the sense of a presumption against such heretofore unheard-of claims, until they are established beyond a cavil, is weak indeed. The obligation is on him to do something with his polygonal drivers which plain round drivers cannot do, and to make it of record, before he complains of bias. This he has not yet done in any records which have come to us. This we are bound to continue to assume' failing proofs to the contrary, he cannot do.—ED. ENG. NEWS.]

THE NICARAGUA CANAL CONSTRUCTION CO. elected the following Board of Directors at its recent annual meeting: WARNER MILLER, A. C. CHENEY, ALFRED M. HOYT, W. L. SCOTT, J. F. O'SHAUGHNESSY, J. W. MILLER, R. A. LANCASTER, J. L. MACAULEY, N. K. FAIRBANKS, SMITH M. WEED, HENRY R. HOYT, ROBERT STURGIS and EDWARD HOLBROOK. The officers of the company are: President, WARNER MILLER; Vice-President, A. C. CHENEY; Secretary J. W. MILLER, and Treasurer, HENRY R. HOYT.

DRILL HOLES ARE BEING SUNK along the line of the proposed Niagara Falls water power tunnel to determine the precise character of the rock, to enable contractors to bid more intelligently.

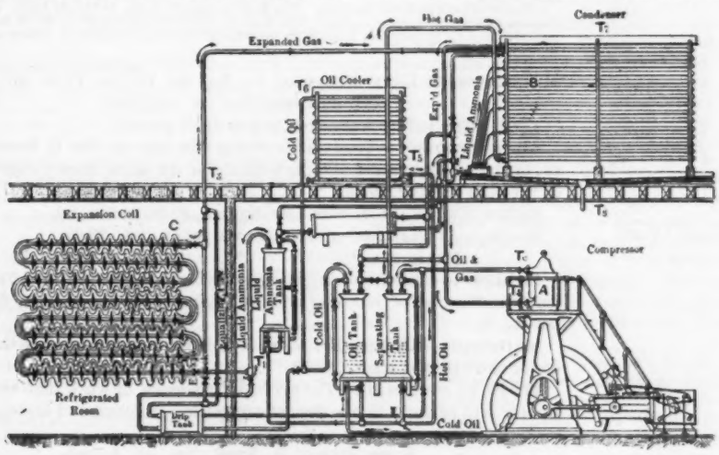
Test of a Refrigerating Plant.*

The test was made by ROBERT M. ANDERSON and C. H. PAGE, Jr., upon a nominal 110 De La Vergne refrigerating plant in Ballantine's Brewery, Newark, N. J., in April, 1887, while they were senior students in Stevens Institute. The test was conducted with all the care and exactness possible under the peculiar circumstances under which it was made. The thermometers, gauges and indicators were standardized at the Institute.

The plant consisted of two boilers, an ammonia compressor consisting of two single-acting upright cylinders driven by a double-acting horizontal Corliss engine, fresh water pumps, hoists and electric dynamos; and, in order that the test should involve only the refrigerating plant, it was made on a day when all the other machinery was not used, and only one of the boilers was fired. No brine was used, but the liquid ammonia and the ammonia vapor were circulated through the cooled cellars. The general arrangement of the parts is shown in the illustration.

A quantity of oil is pumped into each of the compressor cylinders each stroke in sufficient quantity to more than fill the clearance spaces, a part of which passed out of the compressor with the ammonia, and afterwards separated from the former in a "separator," and the remainder leaked through the stuffing and ran down the piston-rod. The volume of ammonia per stroke was considered as equal to the piston displacement less the volume of oil forced into the cylinder, although, on account of the leaking of the oil, the volume of ammonia somewhat exceeded this amount.

The temperature of the ammonia gas in the pipes was determined by inserting the bulb of a thermometer in a pouch filled with mercury, which latter was bound against the pipe on the outside. The correction to be made to the readings was determined by an experiment in the laboratory, in which the thermometer was placed as nearly as possible in the same condition as in the test, the heated fluid passing through the pipe being water whose temperature was measured directly. The maximum difference between the readings of the outside and inside thermometer was about 2° Fahr.



Refrigerating Plant, Newark, N. J.

WEIGHT OF AMMONIA.

In order to determine the weight of ammonia passing through the compressors, it will be necessary to determine the probable mean temperature of the gas when the cylinder is full and the valve closed.

The temperature of the gas entering the compressor was 57.7° Fahr., mean value, and it was compressed to a temperature of 116.1° Fahr., mean value. When the piston is at the upper end of the stroke the cylinder below it will be full of the gas, which entered at 57.7° Fahr.; but the upper end of the cylinder, being hoter than the lower, and being about 116° Fahr., the temperature of the upper portion of the gas will exceed 58° Fahr., and may be nearly 116° Fahr. The piston also being heated will, as it decends impart heat to the gas, the piston becoming cooler in its descent and the gas at the lower end being heated. If the temperature of the walls of the cylinder followed the adiabatic law of compression, and if the temperature of the gas were the same as that of the cylinder at the same heights in the stroke, the mean temperature would be easily found. Since the valve opened at three-fourths of the stroke we would have from equation (18) of Vol. X., *Trans. Am. Soc. M. E.*, p. 643:

Mean temperature = 87° F.

very nearly. It is certain, however, that the average temperature will exceed this: it will be nearer the higher temperature than the lower. Since it cannot be determined it will be necessary to assume a value, and we will take 105° Fahr. This will be 47° Fahr. above the temperature of admission, and only 11° Fahr. less than he highest temperature. The pressure of the gas entering the cylinder was 28.88 lbs., and the pressure in the coils is assumed to be the same.

From the equation of the gas (*Transactions*, Vol. X., p. 640):

$$\frac{pv}{T} = 91 - \frac{16920}{T^{0.97}}$$

we have

$$\frac{28.88 \times 144}{466} v = 91 - \frac{16920}{566^{0.97}};$$

from which we find

$$v = 12.00 \text{ cu. ft.},$$

which is the volume of one pound.

The test lasted 11 h. 30 min., during which time the average piston displacement was 20,177.7 cu. ft. per hour, the volume of the sealing oil was 143.7 cu. ft., leaving 20,034 cu. ft. filled with the gas, so that the ammonia evaporated was

$$20{,}034 \div 12.00 = 1669.5 \text{ lbs. per hour.}$$

REFRIGERATION.

The liquid ammonia entered the cellars at the temperature of 67.4° Fahr.; but, after passing the expansion valves, the pressure fell to 28.88 lbs., absolute, the corresponding temperature being, according to Regnault's experiments, — 2.0° Fahr., as found from the formula (*Transactions*, Vol. X., p. 632):

$$Com.\ log.\ p = 6.2495 - \frac{2196}{T},$$

in which T is the absolute temperature and equals 461 + T, where T is the temperature in degrees Fahrenheit. Hence the fall of temperature was 69.4° Fahr., during which operation heat was imparted to the cellars by the ammonia, the amount being

$$69.4 \times 1.08 = 74.95 \text{ thermal units.}$$

The factor 1.08 is the specific heat of the liquid ammonia at the temperature — 2° Fahr.

The liquid passed along the coils, absorbing heat from the cellars until it was evaporated at the temperature — 2° Fahr., after which the temperature of the vapor was increased to 35.9° Fahr. as it left the cellar. The latent heat of ammonia at — 2° Fahr. is (*Transactions*, Vol. X., p. 640):

$$= 565.6 \text{ thermal units.}$$

The specific heat of ammonia gas being 0.50936 (*Relation des Experiences*, ii., p. 162), the heat absorbed in raising the temperature of the vapor 37.9° Fahr. will be:

$$37.9 \times 0.80836 = 19.27 \text{ thermal units.}$$

The heat removed from the cold room per pound of ammonia pumped will be

$$565.6 + 19.27 - 74.95 = 509.92 \text{ thermal units:}$$

and for the 1,669.5 lbs. compressed per hour, it will be

$$509.92 \times 1{,}669.5 = 851.311 \text{ thermal units.}$$

The latent heat of fusion of ice is 144 thermal units (*Phil. Mag.*, 1871, XLI., p. 182); but, as it is customary to use 142 in these investigations, we will use the same number. This gives for the "ice-melting capacity:"

$$851{,}311 \div 142 = 5{,}995 \text{ lbs. per hour,}$$

or 71.94 tons of 2,000 lbs. each per 24 hours. The average indicated horse power of the engine was 91.13 H. P., so that the "ice-melting capacity" was

$$5{,}995 \div 91.13 = 65.79 \text{ lbs. per hour per I. H. P.}$$

If 30 lbs. of steam were used per I. H. P. per hour, the "ice-melting capacity" was 2.19 lbs. per pound of steam. And if 3 lbs. of coal developed an indicated horse power, then the "ice-melting capacity" referred to coal was 21.93 lbs. per pound of coal.

BOILER.

The efficiency of the boiler was so high on the first trial it was considered advisable to test it again, which was done just a week after the test of the plant above described. This test was for 12 hours. The engine was tested with the boiler the second time, but not the compressors nor the ammonia. This test showed that the engine and feed pump consumed 3.60 lbs. of Lehigh coal per I. H. P. per hour when the average horse power was 102.92. If the same rate of coal consumption existed during the first trial, when the average horse power was 91.13, then the "ice-melting capacity" per pound of coal consumed was:

$$65.79 \div 3.6 = 18.27 \text{ lbs.}$$

And as 1 lb. of coal evaporated 9.6 lbs. of water at 66 lbs. pressure, the "ice-melting capacity" per 10 lbs. of steam evaporated was

$$10 \times 18.27 \div 9.341 = 19.01 \text{ lbs.}$$

If the feed-water be 180° Fahr., and evaporation reduced to what it would be at 45 lbs. pressure, the "ice-melting capacity" would be 19.88 per 10 lbs. steam, provided 3.6 lbs. of coal would produce an indicated horse power at this pressure.

It is not advisable, except in cases of necessity, to combine two tests in one determination, although it is preferable to arbitrary assumptions of coal or steam used per horse power per hour; but any objection to so combining them in this case will be removed by discarding the boiler test and all considerations of fuel and steam, and terminating the investigation with the "ice-melting capacity" per indicated horse power per hour, which is found to be 65.79 lbs.

The following is a summary of the observed and computed quantities:

FUEL, FURNACE AND BOILERS.

The boilers were double return flue, arranged to run automatically, between 60 lbs. and 70 lbs. pressure (gauge).

Test May 22, 1887, 12 hours:		
Fuel, Lehigh nut (anthracite), heat of combustion, from chemical analysis, B. T. U.	12229.6	
Coal actually consumed, lbs.	4447.8	
Combustible, total, lbs.	3577.8	
Coal burned per hour, lbs.	370.65	
Coal per H. P. per hour	3.6013	
Furnace, grate area, sq. ft.	30.	
Ratio of heating surface to grate surface	35.63	
Boilers, heating surface, sq. ft.	1389.	
Water fed per hour, lbs.	3559.7	
Evaporation per lb. coal consumed from and at 212°	10.226	
Evaporation per lb. combustible, from and at 212°	12.703	
Average gauge pressure, lbs.	66.0	
Average temperature of feed-water, deg. F.	180.2	
Efficiency of furnace and boiler, per cent.	80.7	
ENGINE (CORLISS), 32 × 36 INS.		
Piston speed per minute, mean ft.	194.988	
Average indicated horse power, first test	91.13	
" " " second test	102.92	
Water consumed per I. H. P. per hour, lbs., second test	34.104	
Steam per I. H. P. per hour, lbs., second test	25.79	
Steam condensed in the engine, per cent.	24.35	
Average ratio of expansion	5.807	
Steam consumption by the engine per hour, lbs.	3509.45	
Total heat in 3509.45 lbs. steam above 180° .2 F., B. T. U.	3009479.	
Heat changed to work per h., B. T. U., 102.92 × 1980000 ÷ 778 = 261939	261939	
Efficiency of fluid = 261939 / 3009497		0.0721
Coal per I. H. P. per hour for engine and feed-pump, lbs.	3.60	
Combustible per I. H. P. per hour, lbs.	2.91	
COMPRESSOR 2 SINGLE ACTING CYLINDERS, 18×36 INS.		
Average number of revolutions per m.	31.720	
Piston displacement per hour, both, cu. ft.	20179.	
Volume of sealing oil per hour, cu. ft.	143.8	
Volume filled with gas per hour, both, cu. ft.	20036.	
Indicated H. P., mean	76.0892	
Heat eq. of work by compressor per hour, B. T. U.	193645.	
Efficiency of compressor from coal = 193645 / 4332961		0.0407
" " mechanism		0.755
REFRIGERATION.		
Pressure in cooling coil, lbs., absolute	28.88	
Hence, temp. of liquid, deg. F.	—2.0	
Temp. compressed gas, deg. F.	116.1	
" of gas entering the compresser, deg. F.	57.7	
Rise of temperature due to compression, deg. F.	58.4	
Latent heat of evaporation of 1 lb. at — 2.0 F.	565.6	
Superheating in cooling coils, 37°.0 F., B. T. U.	19.27	
Fall of temp. of liquid in cold room, deg. F.	69.4	
Heat imparted to cold room by this fall, 1.08×69.1	74.95	
Heat removed from cold room per lb., 565.6+19.27 —74.95=	509.92	
Ammonia evaporated per hour, lbs.	1669.5	
" " " " B. T. U.	851311.	
Equivalent in "ice-melting capacity" per hour, lbs.	5995.	
" " " " for 24 hours, tons (each 2,000 lbs.)	71.95	
Equivalent in "ice-melting capacity" I. H. P. per hour, lbs.	65.79	
Equivalent in "ice-melting capacity" per lb. of coal consumed at 3.6 lbs. per H. P., lbs.	18.25	
Equivalent in "ice-melting capacity" if 1 lb. coal had evaporated 10 lbs. steam at 66 lbs. pressure, lbs.	19.01	
Equivalent in "ice-melting capacity" per lb. combustible at 2.91 lbs. per I. H. P., lbs.	22.26	
Equivalent in "ice-melting capacity" per lb. ammonia evaporated, lbs.	3.59	
EFFICIENCIES.		
Efficiency of furnace and boiler (see above)		0.807
" " steam utilized by engine (see above)		0.0721
" " engine refered to coal		0.0582
" " compressor referred to engine (see above)		0.755
" " compressor referred to coal 0.755× 0.0582		0.0439
" " refrigeration referred to compressor = 851311 / 193645		4.39
" " refrigeration referred to I. H. P.		
" " of engine	3.31	
" " refrigeration referred to boiler 3.31 × 0.0721		0.238
" " refrigeration referred to coal 0.238×0.807		0.192

that is, for every thermal unit in the coil there was abstracted 0.19 of a thermal unit from the cold room.

* Condensed from a paper by Prof. DE VOLSON WOOD, read at the Cincinnati meeting of the American Society of Mechanical Engineers

TABLES FOR ESTIMATING THE COST OF LAYING CAST-IRON WATER PIPE.

(*Continued from page 581.*)

SUPPLEMENT TO TABLES NOS. 2, 3, AND 5.

The following table gives the items of the actual cost of the labor of laying water pipe and excavating and back-filling for the same, upon which Tables Nos. 2, 3 and 5 were based, with the exception of the cost of carting pipe, which was considered at $1.00 per ton. The table also shows a comparison of the items of actual cost with the amounts that correspond to them in Tables Nos. 2, 3 and 5. The table was computed from records kept in Providence, with the exception of the data that refers to the 48-inch pipe, which was obtained elsewhere.

Length of pipe used in feet.	Excavating, back-filling and laying. 1.‡ Excavating, etc.	2.‡ Laying, etc.	Total of 1 and 2.	Total corresponding to 1 and 2 from Table No. 5, etc.	3. Calking.	4. Teaming	Total of 1, 2, 3 and 4.	Total corresponding to 1, 2, 3 and 4, from Table No. 5, etc.
4-inch, Medium Digging.								
1,214	.....	.....	$.09400	$.09060	$.01300	$.00650	.....	.....
Ave., etc..	.....	.....	$.09460	$.09060	$.01300	$.00650	$.11410	$.11420
6-inch, Easy Digging.								
480	$.06781	$.00959	.....	.....	$.00338	$.01171	.....	.....
422	.10147	.02177	.....	.....	.01173	.01173	.....	.....
380	.06374	.02253	.....	.....	.01067	.01067	.....	.....
533	.07576	.01444	.....	.....	.01098	.01098	.....	.....
201	.09127	.01975	.....	.....	.00564	.01237	.....	.....
378	.06874	.02063	.....	.....	.01518	.01518	.....	.....
401	.09039	.01376	.....	.....	.00899	.01011	.....	.....
416	.07416	.01606	.....	.....	.01083	.01083	.....	.....
364	.05818	.01922	.....	.....	.00925	.00928	.....	.....
191	.08057	.01362	.....	.....	.01373	.01373	.....	.....
320	.05778	.01906	.....	.....	.01053	.01056	.....	.....
711	.05108	.01293	.....	.....	.00854	.00886	.....	.....
545	.05771	.01686	.....	.....	.00950	.00872	.....	.....
1,501	.07488	.02037	.....	.....	.00480	.00524	.....	.....
228	.07017	.01211	.....	.....	.00294	.00496	.....	.....
265	.06566	.01389	.....	.....	.00426	.00423	.....	.....
485	.05567	.01136	.....	.....	.00324	.00326	.....	.....
266	.05677	.01038	.....	.....	.00338	.00338	.....	.....
442	.06493	.01040	.....	.....	.00355	.00358	.....	.....
Ave., etc..	$.06825	$.01577	$.08402	$.08380	$.00827	$.00891	$.10120	$.10350
6-inch, Medium Digging.								
528	$.09366	$.02319	.....	.....	$.01198	$.01198	.....	.....
666	.08989	.01477	.....	.....	.01117	.00981	.....	.....
242	.04906	.01901	.....	.....	.00930	.01115	.....	.....
732	.07204	.01883	.....	.....	.00922	.01014	.....	.....
727	.10241	.01264	.....	.....	.01362	.01208	.....	.....
144	.12185	.04756	.....	.....	.00927	.02034	.....	.....
318	.14775	.01448	.....	.....	.01416	.00919	.....	.....
164	.06288	.01413	.....	.....	.00960	.00866	.....	.....
428	.06301	.01908	.....	.....	.01157	.01157	.....	.....
1,039	.09476	.01625	.....	.....	.01474	.01278	.....	.....
138	.06594	.02638	.....	.....	.01138	.01145	.....	.....
597	.05717	.01540	.....	.....	.01131	.01040	.....	.....
129	.10310	.02155	.....	.....	.01566	.01217	.....	.....
131	.08992	.01637	.....	.....	.01055	.01055	.....	.....
311	.07180	.01479	.....	.....	.00868	.00868	.....	.....
273	.14300	.02817	.....	.....	.01564	.01309	.....	.....
406	.08701	.02227	.....	.....	.00999	.00777	.....	.....
Ave., etc..	$.08918	$.02034	$.10952	$.11230	$.01333	$.01140	$.13425	$.13200
6-inch, Hard Digging.								
265	$.08276	$.02301	.....	.....	$.01275	$.01698	.....	.....
307	.14378	.01645	.....	.....	.01098	.01101	.....	.....
Ave., etc..	$.11327	$.01973	$.13300	$.15480	$.01186	$.01399	$.15885	$.17450
8-inch, Medium Digging.								
496	$.08794	$.02458	.....	.....	$.00907	$.00544	.....	.....
3,743	.06898	.01654	.....	.....	.00541	.00121	.....	.....
529	.07656	.01272	.....	.....	.00425	.....	.....	.....
82	.09756	.01122	.....	.....	.01098	.....	.....	.....
Ave, etc.	$.08276	$.01636	$.09902	$.12730	$.00743	$.00483	$.11130	$.14960
8-inch, Hard Digging.								
157	$.12540	$.02924	.....	.....	$.02147	$.01433	.....	.....
Ave., etc..	$.12540	$.02924	$.15464	$.17000	$.02147	$.01433	$.19044	$.19230
12-inch, Easy Digging.								
1,255	$.09207	$.02388	.....	.....	$.01147	$.00609	.....	.....
Ave., etc..	$.09207	$.02388	$.11595	$.12910	$.01147	$.00609	$.13351	$.15690
12-inch, Medium Digging.								
1,132	$.09627	$.04595	$.14250	.....	$.01193	$.00569	.....	.....
2,161	.....	.....	.12400	.....	.....	.01030	.....	.....
4,283	.....	.....	.10070	.....	.....	.01650	.....	.....
1,785	.....	.....	.13350	.....	.....	.....	.....	.....
589	.....	.....	.16930	.....	.....	.02100	.....	.....
Ave., etc..	.....	.....	$.13394	$.15750	$.01193	$.01337	$.15920	$.18530
16-inch, Medium Digging.								
374	$.22818	$.04904	$.27720	.....	$.02107	$.02045	.....	.....
2,889	.....	.....	.25830	.....	.....	.01820	.....	.....
Ave., etc..	.....	.....	$.26780	$.24900	$.02107	$.01933	$.30820	$.28520
20-inch, Easy Digging.								
242	$.15876	$.04417	.....	.....	$.02508	$.02513	.....	.....
1,450	.15820	.06383	.....	.....	.03010	.04310	.....	.....
Ave., etc..	$.15848	$.05400	$.21250	$.29450	$.02759	$.03411	$.27420	$.34620
24-inch, Medium Digging. (1*)								
19,416	$.32820	$.07310	.....	.....	$.07570	$.02280	.....	.....
Ave., etc..	$.32820	$.07310	$.40130	$.41260	$.07570	$.02280	$.49980	$.51110
24-inch, Medium Digging (2.)								
19,416	$.36940	$.08180	.....	.....	$.07570	$.02280	.....	.....
Ave., etc..	$.36940	$.08180	$.45120	.....	$.07570	$.02280	$.54970	.....
30-inch, Easy Digging.								
561	.....	.....	$.37000	.....	$.08420	.....	.....	.....
Ave., etc..	.....	.....	$.37000	.....	$.08420	.....	.....	.....
48-inch, Medium Digging.								
.....	.....	.....	$1.950†	$1.650†	.....	.....	.....	.....

‡ Including foreman.

* (1) Reduced by proportion to correspond to a depth of 4.67, from (2) 5.43 feet the actual depth.

† These figures include calking. The $1.95 is based upon ordinary labor at $1.75 per day, and $2.00 per day for laying. The $1.65 is based upon labor at $1.50 per day, and was reduced by proportion from $1.95, assuming that the number of layers was 1-10 the number of other laborers.

MISCELLANEOUS DATA RELATING TO LAYING WATER PIPE, ETC., NOT INCLUDING THE COST OF THE PIPE.

Ordinary labor was considered at $1.50 per day.

Short lengths.—Total cost of laying 6-in. pipe per lin. ft. from 15 to 50 ft., including excavating and back-filling for the same; in easy digging, $0.34; in medium digging, $0.45.

Extra Excavation.—In easy digging, $0.20 per cu. yd.

Rock.—Average cost of blasting rock per cu. yd., $2.00
Maximum " " " " 3.00

Bridges.—Cost of crossing bridges, laying pipe, boxing, etc., 12 in., $1.50 per. lin. ft.; cost of crossing bridges, laying pipe, boxing, etc., 8 in. $1.32 per lin. ft.

Railroads.—Cost per lin. ft. of laying 374 ft. of 16-in. pipe that passed under two railroad tracks, $0.50.

Work of one man.—The average proportion of work that an ordinary laborer will perform in one day, at excavating, refilling and laying pipe (not including calking, etc.), is as follows:

In easy digging	21	lineal	feet	of	6 inch
" medium "	17.2	"	"	"	" "
" hard "	10.3	"	"	"	" "
" easy "	19.3	"	"	"	8 "
" medium "	13.4	"	"	"	12 "
" easy "	9.0	"	"	"	20 "
" medium "	4.4	"	"	"	24 "

Average cost of excavation for a 24-in. pipe.—The average cost of excavating and back-filling in medium digging, for a line of 24-in. pipe 19,416 ft. long (the average depth of the trench being 6.60 ft. in depth), with ordinary labor at $1.50 per day, was $0.32 per cu. yd.

TABLE NO. 6.

COMPARISON BETWEEN THE TOTAL COST PER LINEAL FOOT OF THE LABOR OF LAYING WATER PIPE AND EXCAVATING AND BACK-FILLING FOR THE SAME, ETC., GIVEN IN THE PRECEDING TABLES, FOR MEDIUM DIGGING, AND WHAT THE TOTAL COST WOULD BE IF THE TRENCHING, ETC., HAD BEEN BASED UPON $0.30 PER CUBIC YARD INSTEAD OF THE AMOUNTS CHARGED TO TRENCHING, ETC., IN TABLE NO. 5. THE COST OF LAYING, ETC., HAS BEEN CONSIDERED THE SAME IN BOTH CASES.

Diameter of pipe in inches.	At $0.30 per cubic yard. Laying, etc.	Trenching, etc.	Total.	From Table No. 5. Laying, etc.	Trenching, etc.	Total.	Difference from the amounts in Table No. 5.
4	$.0676	$.1382	$.2058	$.0676	$.0833	$.1509	+$.0549
6	.0886	.1506	.2392	.0886	.0968	.1854	+ .0538
8	.1099	.1632	.2731	.1099	.1111	.2210	+ .0521
10	.1334	.1758	.3092	.1334	.1252	.2586	+ .0506
12	.1583	.1890	.3474	.1583	.1392	.2975	+ .0498
16	.2235	.2160	.4395	.2235	.2239	.4474	− .0079
20	.3035	.2447	.5482	.3035	.3154	.6189	− .0707
24	.4876	.2742	.7618	.4876	.3754	.8630	− .1012

In this table, under the division headed "At $0.30 per Cubic Yard," the cost per lineal foot of **Trenching**, etc., is based upon the excavation at $0.30 per cubic yard, measured in the trench, instead of the actual cost, and takes the place of the amounts charged in Table No. 5, for medium digging, to trenching, teaming, and ⅜ the amount charged to foreman and tools, etc. (exclusive of the cost of blocks and wedges, which are included in the cost of Tools, etc., for 24-inch pipe, in Table No. 5). The figures relating to laying, etc., are the same as those charged in Table No. 5 for medium digging, to laying, calking, lead, carting, and ⅛ the amount charged to foreman and tools, etc. (exclusive of the cost of blocks and wedges, which are included in the cost of tools, etc., for 24-inch pipe, in Table No. 5). In each instance, in calculating the cubic contents of the trench, the width was considered as 2 feet more than the diameter of the pipe and ½ of a foot deeper than the water line of the same.

TABLES FOR ESTIMATING THE COST OF LAYING CAST-IRON WATER PIPE.

TABLE NO. 7.

AMOUNT PER LINEAL FOOT TO BE ADDED TO THE FIGURES GIVEN IN THE PRECEDING TABLES FOR RELAYING PAVING, ETC., IN CASES WHEN THE STREETS ARE PAVED BEFORE THE WATER PIPE IS LAID.

Diameter of pipe in inches	4	6	8	10	12	16	20	24	30	36	48
Cobble stones	$0.12	$0 12	$0.12	$0.13	$0.13	$0.14	$0.16	$0.17	$0.18	$0.20	$0.23
Granite blocks laid upon a sand foundation	0.18	0.18	0.18	0.19	0.20	0.22	0.24	0.25	0 27	0.30	0 35
Granite blocks, concrete foundation, joints filled with pea gravel and asphaltum	0.95	0.96	1.01	1.05	1.09	1.18	1.32	1.37	1.50	1.64	1.91

The cost of a square yard of **broken stone** 8 ins. thick, put properly in a street, would be about $0.40.

The figures in this table were based upon a **trench** 3 ft. wider at the surface of the ground than the diameter of the pipe, in order to allow for caving, etc.

The cobble stone paving was considered at $0.30 per square yard, the granite blocks laid upon sand foundation at $0.45 per square yard, and the granite blocks laid upon a concrete foundation, etc., at $2.46 per square yard The granite blocks were estimated to lay from 24 to 27 per square yard.

TABLE NO. 8.

AVERAGE COST OF LAYING LEAD SERVICE PIPE, INCLUDING EXCAVATING AND BACK FILLING FOR THE SAME.

Tap and stop.		Pipe per lineal foot.			
				Laying, etc., etc., including pipe.	
Diameter.	Tap, stop, etc., including tapping.	Diameter.	Weight.	Lead pipe.	Tin-lined lead pipe.
⅜ inch.	$6.00	½ inch.	3.00 pounds.	$0.34	$0.52
½ "	6.23	⅝ "	4.00 "	0.40	0.64
⅝ "	6.81	¾ "	4.75 "	0.45	0.73
¾ "	8.67	1 "	6.00 "	0.52	0.88
1 "	10.71	1¼ "	9.00 "	0.70	1.14
		1½ "	10.00 "	0.76	1.36

The labor of excavating, back-filling and laying, etc., was considered in all cases for lead pipe at $0.16 per foot. **The price** used for lead pipe was $0.06 per pound, and the price for tin-lined lead pipe $0.12 per pound.

Notes and Queries.

J. F. H. writes: Will you please inform me in your next issue when you intend to resume the publication of Wellington's method of transition curves?—When Mr. Wellington is able to furnish the remaining copy, which he hopes to do shortly. Various unavoidable causes, however, have compelled delay.

V. G. H. writes: Some time ago I noticed your statement that you were soon to publish a general index to the ENGINEERING NEWS. Was I mistaken in supposing that this index would be sent to subscribers gratis? [No.] I wish to obtain a copy of this index. Please inform me as to the cost of same and I will remit. [It will be published at the end of the current year, to include this year, and issued free as a supplement to some issue of ENGINEERING NEWS.]

W. E. T., 1431 Webster St., Oakland, Cal., writes: Please inform me of the best method of grading and making heavy street cuts by steam machinery, either to load wagons or portable railway cars. I should like to purchase a practical machine of simple construction, and one not to cost a large amount nor involve much repairs or loss of time in delays. I also wish to purchase second-hand portable railway cars and track, to be had somewhere in this vicinity.

H. C. writes: I should much like to get some information on the subject of laying submerged iron pipe, both wrought and cast, with the *ordinary rigid joints*. I have everything necessary in regard to the flexible wash joint; but it is the matter of laying submerged pipe with common joints that I wish to investigate. If you can put me in the way of getting this information from any party who has had experience in such matters, I shall be much obliged to you. [Information sent to us will be duly forwarded.]

Bridge Inspection in Austria.

The iron bridges on the Kaiser Ferdinand Northern Railway in Austria have been systematically inspected for many years without much expense. An examination of 614 iron bridges with 1,261 spans costs about $7,500 annually. Special officers aided by a number of expert bridge mechanics inspect each bridge in turn, making such minor repairs as are necessary, as driving rivets or tightening screws, and ordering new coats of paint when the structures demand it. Deflection tests and exact observations of the lateral motion of the trusses are made and the general condition of the bridges is carefully examined.

ENGINEERING NEWS.

THE ARTESIAN WELL INVESTIGATING COMMITTEE, made up of Col. E. S. NETTLETON and Prof. ROBT. HAY, which has been investigating the artesian wells in different portions of the west and collecting data with a view of ascertaining to what extent artesian well water can be used in irrigation, has completed its work and returned to Washington. Especial investigation was made of the James River artesian belt in Dakota and the San Luis Valley belt in Colorado. The former was found to be much larger than expected. It extends east and west of the Missouri River underlying a large part of the two Dakotas and draining the eastern slope of the Rocky Mountains. The water is struck at varying depths and in all cases gives a strong steady flow. Inquiries which were made in regard to the use of artesian water for irrigation showed that generally good results were obtained. It is the committee's opinion that the Dakota basin can be depended upon to furnish a permanent supply of water, but whether the topography of the country is such as to ensure its successful use for irrigation is doubtful, the ground being too level in many places to permit of the necessary circulation.

Next to the discoveries in the Dakotas the most important conclusions were developed in the San Luis Valley in Colorado. This valley, which is only about 30 miles long, contains already nearly 3,000 artesian wells mostly of little depth and small pressure, but with a steady flow. It is only necessary to go to a depth of from 80 ft. to 300 ft. to obtain a good flow of water. The supply gives evidences of being permanent. The committee thinks that other valleys of Colorado will develop these same conditions.

Considerable attention was paid to the overflow of the Arkansas River in Eastern Colorado and Southwestern Kansas. The committee is satisfied that the river is underlaid by a wide sheet or bed of sand saturated with water. Evidence was had that this bed was in places 60 miles wide. It is thought that water can be obtained from this bed either by digging wells and pumping the water or by ditching. In Northwestern Kansas an artesian belt of considerable extent was found, but the pressure is not strong, and it is thought that water cannot be obtained in sufficient quantities for irrigation. The committee did not have time to investigate the artesian region of western Texas and other portions of the West which it thinks should be examined. The official report of the committee, which we hope to review at a later day, will be of great importance, as showing the location of the various artesian basins and giving the first definite and satisfactory information on their extent and the supply of water which can be depended upon.

LATER INFORMATION in this connection permits us to give short abstracts from reports made to the Senate Committee on Irrigation by the official field superintendents.

Prof. J. W. GREGORY, whose field extends over Kansas, Nebraska and the public land strip, states that he has located 182 flowing artesian wells, and 107 not flowing, and that he has information showing the existence of ten times as many more of the latter. He has also secured information of several hundred springs large enough to be of value for irrigation. The most important discovery was the finding of acres of subwaters, which Prof. GREGORY states are "so easily accessible" and "of so great extent that their value is almost beyond calculation," and "probably greater than all other sources of irrigation for water supply combined."

In Colorado and New Mexico Prof. L. G. CARPENTER, Division Field Superintendent, reports the following:

The Denver basin, excluding Denver, has 231 wells recorded, nearly all flowing. Denver City has at least 100. Pueblo and Florence have 11 flowing wells. Greely, 10. Scattered in Eastern Colorado are 14, two flowing. New Mexico has 7 wells, one flowing. This does not include the thousands of wells, artesian by definition. San Luis has probably 3,000 flowing wells. Some have estimated 5,000 artesian wells in the valley. Irrigation is practiced only in the Denver and San Luis basins. There are now 100 farmers cultivating 13,000 acres by irrigation from artesian wells in the San Luis.

Mr. F. E. ROESLER, Field Agent for Texas, states that there are about 600 flowing wells west of the 97th meridian. The deepest well is 1,842 ft. deep, and cost $7,200. The shallowest is 15 ft. deep, and cost $15. All of the flowing wells, except 26, are west of the 97th meridian. The greatest flow from any single well is 1,000 galls. per minute; the least, 1 gall. per minute.

For South Dakota, Mr. UPDYKE records: 106 deep spouting artesian wells, with 15 more to be heard from, making a total of 121. Also several hundred shallow wells flowing to the surface.

Agent UNDERHILL, for North Dakota, reports 16 important spouting wells, and several hundred shallow wells, flowing to the surface, within the Red River basin, in the northeast portion of the State.

THE NORTH AMERICAN COMPANY has been organized in New Jersey to carry on a general financiering business, paying especial attention to railway financiering and the promotion of electric light and power enterprises. This company is a reorganization of the old Oregon and Transcontinental Co. The capital stock will be $50,000,000, which will be exchanged for the stock of the old company.

A BANQUET TO THE UNITED STATES ENGINEER CORPS, now on a visit to New Orleans, La., was given by the Chamber of Commerce and Industry of that city on Friday evening, June 13. A large number of prominent men were present, and at the close of the banquet a vote of thanks was given to the United States Engineers and the members of the river commission for their efforts to improve the navigation of the river and levee system.

WIND OBSERVATIONS at the Eiffel Tower show that at low velocities of 15 miles per hour or less, the velocity of the wind at the top of the tower is from four to five times as great as at the top of an ordinary building 60 ft. high; but as the velocity increases, this difference decreases, until at high velocities the difference is only as 2 to 1. M. Eiffel assumed the pressures to be 41 lbs. per sq. ft. at the base, increasing to 82 lbs per sq. ft. at the top, which seems to be rather less difference than the facts called for, although a fair approximation, if the above stated decrease of ratio continues up to maximum wind velocities. During the storm of Feb. 9, 1889, the pressure per square foot at the Forth Bridge, on a surface of 194 sq. ft., was 27 lbs., while the pressure on a surface of only 97 sq. ft. was 41 lbs. From these and similar observations, the *Centralblatt der Bauverwaltung* infers that the pressure per square foot varies inversely as the areas exposed to the action of the wind, the velocity remaining the same. This law is very strongly indicated by other experiments; and we believe i will yet prove to be the true one; yet there is some evidence against it.

A NEW AIRSHIP has been built by a Prof. CAMPBELL in which he proposes to sail over Niagara Falls at an early date. The airship consists of a gas balloon of just sufficient strength to float it a few feet from the ground, and three propellers operated by an electric battery. Two of the propellers will be used to raise and lower the ship, and the third will act as a rudder.

INTERESTING EXPERIMENTS have been made in this same line by Mr. LAWRENCE HARGRAVE, of Sydney, New South Wales, and described by him in a letter to *Engineering*. Mr. HARGRAVE's experiments were made with small models weighing 33½ oz., 1.28 lbs., and 2 lbs. respectively. All three models consisted of a body or back bone and a large horizontal plane, the motive power being elastic bands.

The first had a pair of wings, working like those of a bird, and 470 foot-pounds of energy, sufficient to propel it 270 ft. The second was similar to the first, with the addition of a fore-and-aft sail, and with 193. 208 and 218 foot-pounds of energy it flew 192 ft., 203 ft. and 209 ft. respectively. The third had a screw propeller, and 196 foot-pounds drove it 120 ft. The total area of the models was 2,130 sq. in., 1,980 sq. in. and 2,000 sq. in. respectively, and the percentage of area in advance of the centre of gravity was 19.3 %, 20% and 23.3% respectively.

THE PERCENTAGE COMPOSITION OF THE EARTH'S CRUST has been calculated by Mr. F. W. CLARK and given in a paper entitled "The Relative Abundance of the Chemical Elements," read by him before the Philosophical Society at Washington. In his consideration Mr. CLARK assumed the thickness of the earth's crust to be from the surface to 10 miles below the depths of the sea and included the ocean and the air as a portion of it. According to the calculations nine elements should constitute about 98% of the known matter of the globe. The percentage of the different elements of composition are as follows: Oxygen, 49.98; silicon, 25.30; aluminum, 7.26; iron, 5.08; calcium, 3.51; magnesium, 2.50; sodium, 2.28; potassium, 2.23; hydrogen, .94; titanium, .30; carbon, .21; chlorine and bromine, .15: phosphorus, .09; manganese, .07: sulphur, .04; barium, .03; nitrogen, .02; chromium, .01.

The most noticeable thing in this statement is the comparative rarity of some elements which are supposed to be among the most common, as witness sulphur and carbon. On the other hand titanium, which is supposed to be a very rare element, occupies a high position in the list. In regard to this the author says: "Titanium is rarely absent from the older rocks: it is almost universally present in soils and clays, and it is often concentrated in great quantities in beds of iron ore. Having no very striking characteristics, and but little commercial importance, it is easily overlooked, and so it has a popular reputation for scarcity which it does not deserve." The author gives the percentage of the atmosphere, ocean and solid matter as .03, 7.08 and 92.89 respectively assuming the density of the crust to be 2.5.

THE STREETS OF BOSTON are to be cleared of the many sidewalk stands used for displaying the merchandise of the shopkeepers. The Police Board has announced its intention of enforcing the ordinance passed by the Board of Aldermen this spring prohibiting the use of the sidewalks for displaying merchandise for more than 10 minutes at a time, and have notified the shopkeepers to that effect. This action will result in clearing the streets and sidewalks of all stands and booths which now take up a large portion of the space in some sections of the city. A similar action in New York City would increase the area of the sidewalks at least 50% in many portions of the city.

Advertisements for Contract Work.

No other single publication in the world ever did, or can to-day, exhibit such a variety or amount of advertisements for contract work as may be found in the advertising pages of this journal this week. The list covers tunnels, highways, sewers, water. works, railways, masonry, grading, harbor improvements, brick work, pavements, water-works materials, laying pipe, foreign franchise. The amount of work involved is very large, the location extends over many States and to South America, so that we feel assured that the large list of responsible contractors who depend each week on this journal for this class of news cannot fail to be satisfied. Besides the projects advertised, our news pages record a vast variety of work of great interest to many of our readers. This selection of ENGINEERING NEWS as the especial medium for advertising this class of business is but a natural outcome of years of effort and a large expenditure of money.

As far back as 1876 the collection and publication of contracting intelligence was made a special feature of this journal: it has been maintained ever since and with its rapid growth in circulation, surpassing all competitors, it has very naturally become the favorite medium for exchange of information between contractors and the parties who may need their services.

The usefulness of such a medium is apparent: the cost of the service rendered by the journal is a mere bagatelle as compared to the possible savings of the competition it produces, and as it becomes widely known that every desirable contract is tolerably certain to be advertised in this journal so must the competition increase through the increased number of contractor readers of its columns. As we have stated elsewhere, so we repeat, without fear of contradiction, that for all contract work to be let in North America there is no other method known so quick in action, so fruitful of results, so economical in cost, so satisfactory to all concerned as an advertisement of the work in ENGINEERING NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Pittsburg, Akron & Western.—John H. Semple, Chief Engineer of Akron, O., writes us that grading is actively in progress on this line between Akron and Carey, O., a distance of 109 miles. The narrow gauge line between Carey and Delphos has been widened to standard gauge from Delphos to Blanchard, and work is now in progress between Blanchard and Carey.

Kennebec Central.—Frederic Danforth, of Gardiner, Me., Chief Engineer, writes us as follows:

This road, which has been entirely completed with the the exception of the ballasting, runs from Randolph to Togus, Me., a distance of five miles. The line is 2 ft. gauge, with a maximum curve of 20° and a maximum grade of 190 ft. per mile. The road will be opened for traffic early in July. The officers are: President, Western Lewis, and Superintendent, F. W. Lawton.

Philadelphia & Seashore.—G. S. Williams, of 400 Chestnut St., Philadelphia, Pa., writes as follows:

About 600 men are now at work on this road which is projected to run from Winslow Junction, N. J., via Folsom, Richland, Tuckahoe and Petersburg, to Sea Isle City, N. J., a distance of 35 miles. Twenty-five miles of the road are now completed and in operation, and tracklaying is nearly completed on the remainder of the line. The entire line will be opened for traffic early in July. The roadbed is very favorable, there being no grades greater than 26 ft. per mile, and only a few very easy curves. There are bridges across the Tuckahoe River and Cason's Inlet. The principal business will be in the seaside tourist travel and the local freight and passenger business. C. O. Vanderanter, of Cape May, N. J., was the engineer in charge of work.

Western Maryland.—A press dispatch from Baltimore, Md., says:

The engineer corps of the Western Maryland Railroad is surveying the route of the proposed tidewater extension from Arlington station, where the new road begins, to Jones' Falls. The engineers have finished the work of locating the roadbed from Arlington to Woodbury, and President Hood states that the trouble over the acquisition of property which the road would require in that village has been settled. The board of directors and a number of invited capitalists accompanied President Hood on an inspection tour over the road to-day with a view of examining the Cherry Run and other extensions contemplated by the company to effect its connection with the Philadelphia & Reading. The roadway to be built by the Western Maryland is about 80 miles. The money needed to build the additions is to be raised by the issue of $4,000,000 bonds, bearing 5% interest. These bonds will represent a first mortgage on all roadbeds on which the money is expended, and on all secured to the road by its expenditure. The bonds will be issued from time to time, as the necessities and progress of the work require.

Chicago & West Michigan.—The branch of this road running from Holland to Lake Michigan has been completed and is in operation.

Portland & Rochester.—The contract for grading the short extension of this road to connect with the Boston & Maine, and the Grand Trunk railways at Portland, Me., has been awarded to Richard Shannahan, of Portland. The extension will be 3,700 ft. long, and will cost about $35,000. It is stated that a union station will be built by the three companies at the foot of Preble street.

Woonsocket & Pascoag.—Grading will begin at once on this road. The timber, rails, spikes and other track material have been contracted for and will be delivered in August. A force of men are now clearing the right of way ready for the graders. The road is to be completed before winter, and will run from Woonsocket to Pascoag, R. I., a distance of 12 miles.

Cleveland, Cincinnati, Chicago & St. Louis.—A special meeting of the stockholders of this company will be held on July 7 to consider various important matters, including the proposition to increase the common stock of the company to $25,000,000. At the same meeting will be considered the execution of an operating contract with and the acquisition of the White Water R. R. and the question of issuing $650,000 4% 50-year bonds. Also, the issuance of $10,000,000 4% 100-year bonds, being the purchase price of the St. Louis Division of the St. Louis, Alton & Terre Haute Ry. Co., upon the sale thereof to the Cairo, Vincennes & Chicago Ry. Co. Also, the acquisition by purchase of stock of lease of road between Springfield and Columbus, O., or building an independent line, and the issue of $1,250,000 of bonds for the purpose.

Cleveland & Marietta.—J. A. Hanlon, of Canton, O., Chief Engineer of the Walhonding Valley Ry., writes as follows:

The road is being built in the interest of the Cleveland & Marietta Ry. Co., and is projected to run from Kimbalton, on the C. & M. Ry., via Coshocton, Walhonding, and Warsaw, to Loudenville, O., on the Pittsburg, Ft. Wayne & Chicago R. R., a distance of 68 miles. The work is about average; maximum grade west 21 ft. per mile, and maximum grade east 37 ft. per mile, and maximum curve 8°. There will be a large amount of bridge and masonry work on the line. About nine-tenths of the right of way has been contracted for, and the title of the remainder, consisting of the tow path of the Walhonding Canal is now in litigation. The surveys have all been completed, and the contracts will be let as soon as title to the right of way has been secured. A. J. Warner, of Marietta, O., is President.

Allegheny & Kinzua.—Chief Engineer A. G. McCourt has just completed the survey for a branch to run from a point 5 miles from Red House, Pa., across the Summit, at the head of Stony Creek, and through the West Branch and Big Red House valleys to Zeliff's Mills. The route is through a fine timber region. Work, it is stated, will begin soon. The road is 7 miles long, and in some places the grade is 175 ft. per mile.

Projects and Surveys.

Pennsylvania Midland.—Chartered in Pennsylvania to build a line of railway from a point on the Delaware River, near Stroudsburg, Pa., to a point on the Lackawanna River near Scranton, Pa., a distance of about 50 miles. Among the directors are: John Jermyn, D. W. Jones, John H. Fellows, and Henry M. Edwards, all of Scranton.

Verona Valley.—About $75,000 have been subscribed in aid of the proposed railway to run from Caldwell, N. J., to a connection with the Greenwood Lake R. R.

Toledo & Detroit.—Incorporated in Ohio to build a railway from Toledo, O., to Detroit, Mich. Among the incorporators are: Geo. G. Hadley, Geo. H. Ketcham, Elmer White, and W. W. Adams. These men are all interested in the Toledo & Western R. R., and the new line will probably be run in connection with that road.

Newark & Rochester.—Surveys are reported in progress for a railway to run from Newark, N. Y., via Marion and Lincoln to Rochester, N. Y. The route is through a fine farming and fruit growing section of the State. John Rich, of Marion, and Fred. Peacock, of Lincoln, are interested.

Troy & New England.—A proposition has been made to this company by outside capitalists that the money necessary to build this line will be furnished on condition that the city of Troy subscribes $150,000 in aid of the enterprise.

Toledo & Western.—A correspondent sends us the following:

This company has been organized for the purpose of building a railway from Toledo, O., to Chicago, Ill. The route is about midway between the two lines of the Lake Shore & Michigan Southern R. R., and passes through a rich farming country. The incorporators of the company are all Toledo men. The surveys have been partially completed, and a large amount of local aid has been secured. Contracts will be let about July 1.

SOUTHERN.—Existing Roads.

Georgia Southern & Florida—J. S. McTighe & Co., Macon, Ga., who have the contract for building the Macon & Atlantic R. R., have sublet the following contracts:

Outzen & Welch, sections 1, 2 and 3; White & Co., sections 5 and 6; John Kenney, section 7; Strong, Russell & Conners, sections 9 to 20; J. B. Lewis, sections 20 to 25; S. A. Campbell, sections 25 to 30; Andrew Bro.'s Construction Co., sections 30 to 35; Wallace & Pearsons, sections 35 to 40; James McKinley, sections 40 to 42; McLaughlin Bros., sections 42 to 52; Garvey & Birmingham, sections 52 to 57; Sherry & Moore, sections 57 to 62; A. B. Carter & Co., sections 62 to 67; Donovan & Daly, sections 78 to 82; Henry Pearce, sections 82 to 85; Outzen & Welch, sections 85 to 90; S. McPritchett, sections 93 and 94; Baker & Sons, sections 97 to 102; Hayes Bros., sections 116 to 121.

There remains about 80 miles more of the work to be let, contracts for which will be made as soon as possible.

Seaboard Air Line.—Rapid progress is being made on this road between Chester, S. C., and Athens, Ga. Tracklaying is now in progress from Greenwood, S. C., east, and from Chester west, and will be completed between those points in a few days. The grading has been completed to Abbeville, S. C., 17 miles from the Savannah River. Work is in progress on the bridge across the Savannah River. Two of the piers have already been erected and the substructure will be finished ready for iron work by the time tracklaying is finished to the river. Between the Savannah River and Athens, Ga., large forces of men and teams are at work.

Danville & New River.—This road, running from Danville to Stuart, Va., is advertised for sale on Aug. 27. It is thought that the Richmond & Danville R. R. will pur-

chase the line, and probably extend it west to the Cumberland mineral region.

Louisville & Nashville.—A large force is now at work widening the gauge of the Anniston & Atlantic R. R. Standard-gauge rails have been laid on the entire line, but the ballasting and bridging have not been quite completed. The surveys have been finished, and work is now in progress on the extension from Sylacauga to Calera, Ala. This line is to be completed and in operation by October.

Roanoke & Southern.—At the annual meeting of the stockholders recently held the contracts were let for the section between Martinsville and Roanoke, Va.

Way Cross Air Line.—Surveys, it is stated will soon begin for the extension from Way Cross to St. Mary's Ga. Work is now in progress between Cordele and Way Cross. Loring B. Miller, 16 Beaver St., New York City, is President.

Norfolk & Western.—The officers of this company have incorporated three companies in West Virginia to build railways as feeders to the road. The Logan & Fairview R. R. Co. will build a line along Twelve Pole river, in Logan county. The Chatesawha & Guyandotte R. R. Co. will construct a road from a point on the Elkhorn extension up the Guyandotte river, a distance of 150 miles. The Warfield & Big Sandy R. R. Co. will construct a line along the valley of the Tug river.

Paducah, Tennessee & Alabama.—Grading is making good progress on this line between Paducah, Ky. and Paris, Tenn. The road will ultimately be extended from Paris to Florence, Ala.

Middle Georgia.—It seems probable that this old project will be carried to completion. The company was chartered in 1881 to build a railway from Tennille or Sandersville. Ga., to Union Point, Ga., but since that time the Union Point & White Plains R. R. has been constructed over a portion of its route with the intention of extending to Sandersville ultimately. It is now stated that the two interests will be consolidated and the road built as originally projected. M. Newman has been elected President of the new organization and H. N. Hallifield Secretary and Treasurer.

Louisville Southern.—Work on the Richmond, Nicholasville, Irvine & Beattyville R. R. is making satisfactory progress. It is expected that the grading will be completed to Nicholasville in about a month. The rails and other truck material are on the ground, and the line will be rapidly completed.

Projects and Surveys.

Dahlonega & Dawsonville.—Frank W. Hall, of Dahlonega, Ga., writes us as follows:

This road is projected to run from Tate's Station, on the Marietta & North Georgia R. R., via Dawsonville and Dahlonega, to Lula, on the Anniston & Cincinnati R. R., a distance of 65 miles. The route is through a fine agricultural and mineral section of the country, affording light work. All of the right of way has been obtained and a considerable amount of local aid has been secured. The company was chartered Sept. 28, 1889. James P. Harrison is President and P. B. Lawrence is Chief Engineer, both of Atlanta, Ga.

Mobile, Jackson & Kansas City.—M. B. Bond, of 36 St. Francis St., Mobile, Ala., writes us as follows:

This road is to run from Mobile, Ala., crossing the Mississippi State line at the Dog River, and via Hattiesburg, Williamsburg, and Brandon, to Jackson. Miss., a distance of 184 miles. The locating surveys were made last year, and have been thoroughly revised the present season. The route is through a good timber region, affording light work; maximum curve 1°, and maximum grade 1%. There will be three 125-ft. and two 200-ft. spans of bridge work. The principal business of the road will be in timber, wool, cotton, grain and general agricultural produce, and merchandise from Mobile to supply the local demands. About 90% of the right of way has been donated and $475,000 in county and city bonds and by private subscription to the stock have been obtained. The Anglo Southern Construction Co., which was organized to construct the line will let the contracts in about 2 months. It is expected that the road will be completed and in operation by Jan. 1, 1892. H. Austill is President, and T. W. Nicol is Chief Engineer, both of Mobile, Ala.

Morristown and Cumberland Gap.—F. H. Allen, of Morristown, Tenn., Vice-President, writes as follows:

This road is to run from Morristown, Tenn., to a connection with the Knoxville, Cumberland Gap & Louisville R. R., a distance of 40 miles. The work is generally heavy; maximum grade 75 ft. per mile, and maximum curve 6°. There will be several bridges, the most important of which will be the one across the Holston River, 500 ft. long. The surveys will be completed by July 1, and the contracts will be let on July 6. It is expected that construction will be commenced by July 24 and the road completed in 10 months. Chas J. Allen, of Morristown, Tenn., is the Chief Engineer of the road.

Carolina Southern.—Wm. Moncure, of Cheraw, S. C., Chief Engineer, writes that the preliminary surveys are nearly completed for this road, which is to run from Cheraw to Sumter, S. C., a distance of 63 miles. The work is generally light; maximum grade, 52.8 ft. per mile and maximum curve 3°. The route is through a farming country, and the principal business of the road will be in farm products and supplies. W. G. Childs is President.

Virginia & Kentucky.—J. C. Wrenshall, of Danville, Va., Chief Engineer, writes us that the surveys for this road commenced June 1, and are now well under way. The road is to run from Stuart, Va., the western terminus of the Danville & New River R. R., via Hillsville to Tazewell C. H., Va., and then down the Clinch River to and across Sandy Ridge, and down the Big Sandy River to the Ohio River, a distance of about 150 miles.

Fincastle & Troutville.—Edmund Grover, of Iron Gate, Va., Chief Engineer, writes us as follows:

The preliminary survey has been completed for this road, which is to run from Fincastle to Troutville, Va., a distance of 6¾ miles. The work is light; maximum grade, 2.8%, and maximum curve 20°. The object of the road is to connect Fincastle, the county seat of Botetourt County, with the railways, and to open up valuable quarries of limestone and marble. The right of way will probably be donated. Wm. B. Simmons, of Fincastle, Va., is President.

St. James City & Punta Gorda.—The surveys have just been completed for a railway to run from St. James City to Punta Gorda, Fla., a distance of about 20 miles. It is stated that the road will be completed in time for the Winter travel. Frank P. Damon is Chief Engineer.

Chicago & Birmingham.—Press reports state that a railway is to be constructed from Chicago to Birmingham, Ala. There is little probability of such a line being built.

Charleston, Kentucky & Western.—A meeting of business men was recently held at Mt. Sterling, Ky., to organize this company. It is proposed to construct a railway from Cincinnati, O., via Carlisle and Mt. Sterling, Ky., and Morristown, Tenn., to the Atlantic coast. An executive committee was appointed to carry out the preliminary work. Surveys will, it is stated, be made at once. T. J. Glenn, of Carlisle, Ky., is interested.

Gauley & Twenty-Mile.—Chartered in West Virginia to build a railway from Belva, Nicholas County, up Twenty-Mile Creek to Summersville and thence up Bill Creek to near the mouth of Blue Creek. Among the incorporators are: D. E. Cheney, M. A. Cheney and F. O. Havener, all of Kanawha, W. Va.

NORTHWEST.—Existing Roads.

Missouri Pacific.—E. P. Reynolds & Co., of Wymore, Neb., are reported to have the contract for building the line from Union to Omaha, Neb.

Projects and Surveys.

Sioux Falls & Huron.—Chartered in South Dakota to build a railway from Sioux Falls to Welsey, So. Dak., a distance of 110 miles. The headquarters of the company will be at Huron, So. Dak.

Effingham & Carmi.—A project is on foot to build a railway from Effingham to Carmi, Ill., via Sailor Springs, Clay City and Merriam. The route is through a good agricultural section.

Dakota, Wichita & Galveston.—This company has been chartered to build a railway from Bismark, No. Dak., to Galveston, Tex., a distance of 2,000 miles. The directors are: C. Eisenmayer, Jr.; J. Winkler, J. D. Lange, W. F. Gehur and James Dow, all of Halstead, Kan.

SOUTHWEST.—Existing Roads.

Dallas & Oak Cliff.—T. L. Marsalis, of Dallas, Tex., writes as follows:

The Dallas & Oak Cliff Railway Co. was chartered in May, 1887, and built a line from the Courthouse at Dallas across the Trinity River and bottom over a standard steel and iron bridge and one mile of standard trestle out into the hills on the south side where the residence and manufacturing city, Oak Cliff, now is. Two years ago there was not a house on that side of the river; the town has now a population of 7,000 people. About the first of the present year we commenced to extend this line of railway in a circle back to the Courthouse at Dallas, ballasting the roadbed with 12 ins. of stone and gravel, building an additional mile of trestle and another steel and iron bridge across the river and bottom, connecting the line at the Courthouse at Dallas, making a belt line of about 10 miles. We use the same motive power and equipment as the New York elevated railway, making stops every thousand feet on the line, and running trains from the Court ouse every 15 minutes, from 5 A. M. until 2 A. M. This line carried 3,000,000 passengers last year. In constructing the belt we used a charter granted to the West Dallas Ry. Co., with a capital stock of $100,000. One mile of road was built on this charter, and 9 miles with the Dallas & Oak Cliff Ry. charter, making the capital stock of both companies $350,000. Aside from the heavy expense of two steel bridges and about two miles of trestle, the road is built through hills, requiring some very heavy stone cuts. The track is laid with 56 and 60-lb. steel rails. The maximum grade 1¾% and the maximum curve 6°.

Denison, Bonham & New Orleans.—At a meeting of the directors of this company recently held in Denver, a number of the directors resigned and a new board was elected as follows: S. B. Allen, of Bonham, President; W. B. Munson, of Denison, Vice-President; W. H. Abrams, R. S. Lovett, John A. Grant, R. Fanby, and L. S. Thorne, of Dallas, George J. Gould, of New York, Paul Wapley, of Denison, W. B. Munson, Treasurer; L. S. Smith, Assistant Treasurer. Steps were taken to amend the charter to provide for the extension of the line to Red River on the north and also south through Guyson Co. Mr. Lovett states that work on the main line from Denison to Bonham will commence immediately, and on the other two divisions as soon as the charter is amended. The line to Red River will run north through Indian Territory, tapping valuable coal fields there, thence to a connection with the Gould system.

Projects and Surveys.

Kansas City, Arkansas & New Orleans.—We have received the prospectus of this road from which we take the following:

The company was incorporated in the states of Missouri, Arkansas and Louisiana to build a railway from Kansas City, Mo., to New Orleans, La.; but it is the intention to build the road from Beebe, Ark., to Monroe, La., only, for the present. The route has been entirely surveyed and passes through a country rich in agricultural land and timber. The total length of the road from Kansas City to New Orleans is 777 miles and the length of the section to be built at once is 194 miles. The officers of the company are: D W Jones, President; W. R. Woodward, Vice-President; Chas. P. Packer, Treasurer; Geo. D. Foster, General Manager, and A. W. Foster, Secretary.

Corpus Christi & South American.—The surveys have been completed for this road, and it is announced that work will commence about July 4.

Corsicana & Southwestern.—The engineers have completed two preliminary surveys for this road and report a very favorable line secured. The road is to run from Corsicana, Tex., to the International & Great Northern R. R., a distance of 50 miles. Chas. H. Allyn, of Corsicana, is President.

Rocky Mt. and Pacific.—Existing Roads.

Union Pacific.—Work broadening the gauge of the Utah & Northern R. R. is being pushed vigorously. Track is being laid at the rate of 2 miles a day, the work being prosecuted from McKammon south and from Ogden north, and the grading is advancing from several points. The main line will be equipped with the standard gauge rolling stock and trains will be running by September 1. The Cache valley loop is to be ready 30 days afterwards. The force of men is being increased. The total cost of the improvement is put at $2,000,000.—A narrow-gauge railway is to be built as a feeder to the Union Pacific from Baker City, Ore., 25 miles into Pleasant Valley lumber district. Among the projectors ar ex-Mayor Eccles and Charles Nibley, of Ogden, and W. W. Riter and Bishop Sharp, of Salt Lake City. Joseph R. West, of Ogden, is Chief Engineer. Right of way is now being secured and arrangements are practically made with the Union Pacific Co. whereby the road is to furnish it with all its ties and timber generally.

San Pete Valley.—It is expected that the transfer of this road to the Union Pacific will soon be made. As soon as this is done it is announced that the road will be extended through San Pete and Sevier counties.

Denver & Rio Grande.—A large amount of track material is on the ground, and it is expected that its Chandler Branch will be completed early in July. Work on the branch to run from Florence, Colo., to a mine, a distance of about two miles, will be commenced soon.

Great Northern.—Vice-President Clough is quoted as speaking as follows in regard to the western extension:

"The only thing that delays the beginning of work is the definite selection of a route. The money necessary for the completion of the work was raised in London. We re marketed our bonds there, and two days after the books were opened $16,000,000 were subscribed. We will certainly begin work on our line to the coast before September. We have had surveying parties in the field for months. They have located at least three passes through the mountains and as many different routes. As soon as we decide which s the most feasible we will begin construction of the line."

Union Pacific, Denver & Gulf.—F. E. Bissell, of Denver, Colo., Ghief Engineer, writes as follows:

This company is building an extension from Martensen, Colo., to the Red River and thence up and down the Red River a distance of 30 miles, of which 4 miles are in Colorado and 26 miles are in New Mexico. The work is heavy, their being considerable rock-work; maximum curve 16°, and maximum grade 3½%. There will be two large, double-deck trestles on the line. J. R. De Remer, of 1,435 Pearl St., Denver, Colo., has the contract for building the line, and about 90 teams and 160 men are now at work on the line. About 8 miles of the grading have been completed and 2 miles of track laid. It is expected that the road will be opened for traffic by Aug. 5. C. N. Knickerbocker, of Trinidad, Colo., is the engineer in charge of work.

Southern Pacific.—This company has completed the surveys, and will, it is stated, soon commence construction on a line from Martinez through the Ramon Valley to a connection with the main line somewhere in the Livermore Valley.

Projects and Surveys.

Rio Grande & Salt Lake.—At a meeting recently held the following officers were elected: President, B. L. Cook, Secretary and Treasurer, Geo. D. Cook, and Chief Engineer, V. D. Simcar. Preliminary steps were taken toward the construction of the road and it is announced that work will commence in a short time. The road is projected to run from Durango, Colo., to Algodones, N. M., and was surveyed some time ago, but nothing has been done since. It is now announced that the necessary capital has been secured and that the road will be built.

San Francisco & Los Angeles.—A meeting will be held at San Jose, Cal., soon to consider the construction of a railway from San Francisco to Los Angeles, Cal., running along the coast.

Coos Bay, Roseburg & Eastern Ry. & Navigation Co.—This company has been chartered in Oregon to build and operate a railroad, telegraph line, etc., from the south side of Coos Bay, via Roseburg, to the eastern line of the State; capital stock, $2,000,000; incorporators, I. Sheridan, W. S. Hamilton, A. Marks, A. M. Crawford, E. G. Flanagan, J. W. Bennett, J. F. Miller and D. S. K. Buick.

FOREIGN.

Mexico.—The Government has authorized the construction of a railroad from the city of Mexico, via Toluco to Zihuatanejo, on the Pacific Coast.

Congo.—Over a thousand Africans are now at work on the Congo R. R. On April 12, two miles of it had been completed. This portion begins at Natadi, which is at the western end of the road, 90 miles from the sea. The principal difficulties lie in the building of the first 10 miles.

India.—The Indian Government has granted a company a subsidy of one-half a lac of rupees annually for ten years and one lac annually for a further period of ten years to construct a railway from Simla to Kalka.

RAPID TRANSIT.

Inclined Road.—*Duluth, Minn.*—Plans for the line are completed and some of the contracts let. The grade varies from 15 to 24%.

Cable Railways.—*New York, N. Y.*—The Third Ave. line has received permission from the Court of Appeals to put in a cable plant.

Pittsburg, Pa.—A line is proposed between this city and Mt. Washington.

St. Louis, Mo.—The St. Louis Cable & Western Ry. has been sold to Lee, Higginson & Co., Boston, Mass., for $150,000.

Chicago, Ill.—The Milwaukee Ave. line has been opened for a distance of two miles.

Horse Railways.—*Amesbury, Mass.*—A line is projected between this place and Exeter.

Germantown, Pa.—A double track railway will be built.

Danville, Va.—The company here will build about a mile of new line.

Batesville, Ark.—Surveys have been made for lines here.

Minneapolis, Minn.—The system will be extended to Robbinsdale.

Austin, Tex.—The Houston & Irvington Ry. has been incorporated by J. P. Irvine, C. B. Foster and B. Kian, Capital stock, $100,000.

Centralia, Ore.—Work will commence at once on the system here.

Electric Railways.—*New Bedford, Mass.*—The Union Co. will adopt electricity on all its lines.

East Hartford, Conn.—A freight and passenger line to Glastonbury is projected.

Hudson, N. Y.—The line will be opened about Aug. 1.

Long Branch, N. J.—It is proposed to connect West End and Pleasure Bay.

Pittsburg, Pa.—A 4-mile line has been surveyed to Squirrel Hill.

Gadsden, Ala.—A line will be built by Hughes & O'Connel.

Austin, Tex.—The Austin Street Ry. is doubling its track and will adopt electricity.

Galveston, Tex.—The street railways here will adopt electricity at once.

Wichita, Kan.—Several miles of line are under construction.

Put-in-Bay, O., will build a short line.

East Cleveland, O.—Horses will give way to the electric motor on the Central Ave. line.

Sioux City, Ia.—At least two miles of line will be built this Summer.

Minneapolis, Minn.—There are 17 miles of electric roads here.

Seattle, Wash.—A company has been incorporated to build four miles of line by J. Leary & J. F. McNaught. Capital stock $500,000. A trolley line will be built on Broadway.

HIGHWAYS.

New York.—Attention is called to the advertisement in another column for macadamizing in Dunkirk, N. Y.

The sum of $20,000 has been voted for improving the roads in Westchester County.

WATER-WORKS.

NEW ENGLAND.

Cape Elizabeth, Me.—We have received the following information from Thomas P. Place:

At a meeting held on June 13, the town officials reconsidered the action taken in the March meeting, and those present were unanimous to rescind the former action. For "former action" see ENGINEERING NEWS of March 15, page 261.—ED.]

Bath, Me.—The water supply is to be increased. The proposed plan is to sink a well near Thompson's Brook. Additional pumping machinery will probably be purchased.

Derry Depot, N. H.—Surveys are being made for the pipe lines.

Portsmouth, N. H.—A proposition has been received by the City Council to put in a water service costing $180,000, the supply to be obtained one mile from the present source.

West Rutland, Vt.—A company will probably be organized to supply the town with water. The proposed capital is $25,000. Dr. J. D. Hanrahan and J. M. Davis are interested in the organization of the company.

Great Barrington, Mass.—The Berkshire Heights Water Co., has offered to sell its plant to the fire district for $45,000.—The Great Barrington Water Co. want the same amount, but the committee declined to entertain the offer. It was then voted to petition the Supreme Court to appoint commissioners to appraise the property of the company.

Stockbridge, Mass.—Works to cost $150,000 will be built.

Providence, R. I.—Repairs are to be made to the Fruit Hill reservoir. Estimated cost, $75,000.

MIDDLE.

East Aurora, N. Y.—A majority of the citizens are reported to be in favor of having a Holly system of works put in, and a citizens' vote will be taken on July 7. Mr. Shuttleworth, of Springville, N. Y., has looked over the ground with a view to submitting a proposition.

Sea Cliff, N. Y.—Six wells, for fire protection, are to be put down. Bonds will be issued.

Long Island City, N. Y.—An appropriation of $6,000 has been made for sinking additional supply wells.

Cohoes, N. Y.—The City Council has passed an order providing for the issue of $25,000 of bonds. They are to be disposed of at auction in values not exceeding $5,000.

Hoosick Falls, N. Y.—The Water Committee has submitted its report relative to the proposed works. The estimated cost for laying pipes and building reservoirs at Little White Creek, and taking the water to Hoosick Falls is $95,760. Engineer E. D. Smalley, of Canastota, has been ordered to draw plans and specifications for the work.

Rochester, N. Y.—The Donaldson Iron Co., of Emaus, Pa., has been awarded the contract for furnishing cast-iron water pipe in the following quantities: 40 tons 12-in.; 168 tons 10-in.; 56 tons 8-in.; 215 tons 6-in.; 42 tons 4-in.; 25,000 lbs., special castings. The contract price is $13,435.63.—The contract for water meters has been awarded to the American Frost Meter Co., of Boston, Mass., at the following rates: ¼-in., $13; ¾-in., $21.50; 1-in., $28.50; 1¼-in., $52; 2-in., $72; 3-in., $145; 4-in., $290. The board will also purchase from the Holly Mfg. Co., of Lockport, N. Y., a No. 5 Gaskell duplex com. con. pumping engine, guaranteed to deliver 1,500,000 galls. of water daily. This pump will be used at the Gates well. It is to be delivered, upon foundations laid by the city, at $4,950. A boiler will be furnished for $1,200, and an iron stack, 70 ft. long by 30 ins. in diameter, at $240. The total cost of the plant will be $6,390.

Southampton, N. Y.—It is proposed to build a system of works to cost $40,000. J. H. Pierson, J. M. Thomas, and others, are interested in the project.

Berlin, N. Y.—The Water Committee has reported to the Common Council in favor of granting a 20-years' franchise to a company, the town to pay $1,000 per year. The specifications require that mains shall be laid in all of the principal streets, and that water shall be pumped direct, furnished by gravity or pumped to a stand-pipe or reservoir, as the committee in charge may decide upon. They also recommend that the town vote $15,000 of bonds. The next meeting will be held on July 15.

Lester, N. Y.—J. M. Warner has sent us the following:

Address G. Harris Lester, Lestershier, Broome Co., N. Y., for information regarding the projected works.

Woodstown, N. J.—We have received the following information from W. D. Clayton, Clerk of borough:

The Common Council is considering the question of building works, but no definite steps have been taken. A stock company may be formed, the borough holding a majority of the stock. The town has received propositions from outside parties to furnish the town with water and put in hydrants at a stated price per year, but no contracts have been made.

Kearney, N. J.—The Water Purveyor has been directed to have mains laid in North Midland Ave.

Jersey City, N. J.—Considerable additional trouble from the water supply is anticipated in the way of impurities, to be caused by the recent decision of the Court of Errors and Appeals, giving the City of Passaic the right to empty its sewage into the river.

Freehold, N. J.—Acton C. Hartshorne is President, and John Enright, Secretary, of the Water Committee.

Macungie, Pa.—Works are projected.

Philadelphia, Pa.—The estimated cost of the new reservoir, to be located at Roxborough, is $400,000.

Allegheny, Pa.—It is now proposed to ask for bids for constructing a 60-in. main from Nine-mile Island to the city, and also for building a new reservoir, and putting in a filtering plant. The plans and specifications have been completed, and the object in asking for estimates for the above work is to enable the officials in charge to bring before the citizens a definite and intelligible proposition, upon which a vote will be taken.—Sealed proposals for $100,000 of 4 per cent 20-year renewal water bonds will be received until June 30 by James Brown, Comptroller.

Washington, D. C.—Sealed proposals will be received until June 30, for furnishing 75 fire and 50 street hydrants. For specifications, etc., apply to J. W. DOUGLASS, L. G. HINE, or H. M. ROBERT, Commissioners.—Bids for furnishing cast-iron water pipe, special castings and water valves, will also be received by the same commissioners until July 5.

Wilkes-Barre, Pa.—The Wilkes-Barre Water Co. is now at work on the scheme to obtain their water supply from Huntsville Creek. Two large reservoirs are being constructed on the creek about 8 miles from the city, and a 30-in. main is being laid.

SOUTHERN.

Elkins, W. Va.—The Ohio Valley Improvement Co. has been incorporated by H. G. Davis, S. B. Elkins and others, to build works. Capital stock, $20,000.

Winston, N. C.—The town has voted to issue $200,000 of improvement bonds, part of which are to be used in purchasing and improving the water supply.

Aiken, S. C.—The City Council has decided to bore an artesian well in the city, and a committee has been appointed to correspond with artesian well borers and get estimates.

Savannah, Ga.—It has been proposed to adopt meters, and the task of furnishing information to the City Council regarding them, the cost of putting them in, etc., has been referred to a committee. Alderman Carson is interested in the matter.

Macon, Ga.—The Board of Trade has passed a resolution stating that any action taken to provide for an increased supply of water, either by legal steps or to compel the fulfillment of the existing contract, or to provide for future contingencies by the erection of new works by the city, or other parties, will receive its co-operation as well as that of the Mayor.

Uniontown, Ala.—It is reported that a stand pipe is to be erected.

Nashville, Tenn.—Press dispatches state that considerable damage has been done to the pumping machinery, by a destructive fire, at the old works on Rolling Mill Hill.

Parkland, Ky.—The question of introducing a water supply is being discussed. Address W. J Wilson.

Winchester, Ky.—A stand pipe 25 ft. in diameter by 75 ft. will be erected, and 4 miles of 12 to 4-in. pipe will be laid. A 2,000,000-gall. pumping engine will be required. Wheeler & Parks, of Boston, Mass., have secured the franchise and will build the works.

NORTH CENTRAL.

Marysville, O.—At a special election to vote on the question of putting in works, held on June 23, a franchise was voted to a local company to build a system by a majority vote of 240. A proposition that the town build them was lost by a majority of 386 votes.

Edgerton, O.—Works are projected.

Findlay, O.—Superintendent D. A. B. Bailey has sent us the following information:

About 8 miles of 10, 8, 6 and 4-in. pipe will be laid this season, and 55 hydrants and 40 new valves will be set.

Goshen, Ind.—Improvements costing $12,000 will be made this season.

Imlay City, Mich.—Sealed proposals will be received until July 11 for constructing a system of works. For further information see our advertising columns. The members of the committee on water-works are: President, Charles S. Marshall, E. E. Palmer, T. B. Keyworth and William A. Sleeman.

Belleville, Ill.—Madison T. Stookey, Receiver of the City Water Co., has sold the Belleville works with all its franchises, under a decree of the U. S. Circuit Court, to Messrs. Eastman, of Concord, N. H., and Cook and Pendleton, of Rhode Island, representing the first mortgage bondholders, at $102,000. The decree of sale was obtained by the American Loan and Trust Co., of New York, which held $150,000 of the City Water Co.'s bonds.

Galesburg, Ill.—Sealed proposals will be received until July 1 for furnishing material and labor, and doing the work required for building a system of works. Chester B. Davis, of Chicago, Ill., is the Engineer. John C. Stevens, City Clerk.

Centralia, Ill.—The Enterprise Co., recently formed to develop a water supply from an artesian well, has been dissolved.

Ipava, Ill.—The Ipava Water-Works Co. has been incorporated to construct and sublet contracts for a system of works. Capital stock, $70,000. The incorporators are: P. M. Starnes, Calvin Branson and J. W. Quillen.

Milwaukee, Wis.—All the bids opened on June 20, for constructing the new water tunnel were rejected as being too high, and new proposals are now wanted.—The above work, 3,000 ft. of tunnel, was advertised in this journal on June 7 and 14.

Oconto, Wis.—The town has contracted for a Holly system of works. The city takes 500 hydrants at a rental of $65 each per annum. The plant is to be completed in one year from date and will cost $125,000.

NORTHWESTERN.

Sioux City, Ia.—Sealed proposals will be received by L. H. Drumm, Chairman Water Committee, until July 8, for furnishing, laying and completing approximately the following quantities of cast iron water pipe: 13,345 ft. 8-in., 42 lbs. per ft; 10,540 ft. 6-in., 33 lbs.; 3,080 ft. 4-in., 22 lbs.; about 22,226 lbs. special casting, 29 double nozzle, Mathews fire hydrants, 10 8-in., 8 6-in. and 5 4-in., Ludlow valves.—R. E. Purslow & Co. have completed the sinking of 30 wells, and they have been accepted by the city.

Creston, Ia.—Work has been stopped by creditors attaching the property of the contracting company. The amount of the attachment is about $18,500. It is reported that unless the company can redeem the claims a new local company will be organized and the works completed by them.

Chatfield, Minn.—Works are being constructed.

Abilene, Kan.—The following is taken from the Topeka *Capital*:

The perennial water-works question is again up for discussion and has aroused considerable feeling. The City Council has refused to pay the semi-annual rental and the company does not know how to improve the present supply. The newest proposition is to bring the water by pipes from Sand Springs, four miles distant, where an abundance of fine water is obtainable.

Horton, Kan.—Bids are wanted for furnishing a water supply. The plant was put in 1887.

Beatrice, Neb.—At a recent special meeting of the City Council the contract for the extension of mains was let to W. H. Duffett & Co, at $9,112.

Rawlins, Wyo.—Bonds for $15,000 will be issued for sinking an artesian well.

SOUTHWESTERN.

St. Louis, Mo.—Bids for constructing Section A of the new conduit will be received until July 8 by G. Burnet, President. O'Donnell & Bros. have forfeited their contract with the city.

Galveston, Tex.—The question of sinking a well to a depth of 2,000 to 3,000 ft. to ascertain if an adequate supply of pure water cannot be secured from this source, is being considered. The estimated cost is $20,000.

Houston, Tex.—Supply well No. 15 has been completed by G. Warnecke, the contractor. It is 500 ft. deep, and flows 400,000 galls. per day.

Denver, Col.—The Board of Aldermen has passed an order directing the Denver Water Co. to set a number of additional hydrants.

Montclair, Col.—(A suburb of Denver, Col.)—The citizens of Montclair have cast a large majority in favor of ratifying the ordinance, contracting with the Denver Water Co., for 20 years, for a water supply for fire protection and domestic use. The work of laying the pipes and putting in the hydrants is progressing rapidly. The mains on the principal streets are 12 to 6 ins. in diameter.

PACIFIC.

Dayton, Wash.—At the election in July the proposition to bond the city for $55,000 for putting in works will be voted upon.

Sea Haven, Wash.—(A suburb of Tacoma, Wash.)—A water supply is to be put in by Thomas Potter. Springs will be the source of supply.

Myrtle Point, Ore. The Myrtle Point Water Co. has been incorporated by Daniel Giles, E. Binder, W. F. Harris, J. F. Weston and W. L. Dixon, to put in works. The capital stock is $5,000.

The Dalles, Ore.—We have received the following information from M. T. Nolan, Secretary Water Commission:

Contracts will be let on July 17. Specifications of pumping system are on file The Water Commission, J. F. Moody, Chairman, will consider propositions for any system that may be proposed by any bidder outside of the bids for the system proposed. The city sold $100,000 of bonds on April 15. The proposed plan is to pump water from the Columbia River to a reservoir. Water is to be furnished for fire protection and domestic supply. No engineer has been appointed. M. A. Moody is Mayor. The population is between 4,000 and 5,000.

Astoria, Ore.—An arrangement has been made whereby Dr. Thompson will sell his interest in the works to a Chicago company. Between $100,000 and $150,000 will be expended in putting in a complete and efficient system.

Salt Lake City, Utah.—The following resolution has been passed by the Common Council:

That the Board of Water Commissioners be authorized to prepare the necessary plans and specifications for the construction of the works for the water supply from Parley's and Emigration Creeks, and invite proposals for such construction and perform such other work as may be essential in the premises, all of which shall be subject to the approval of the Council.

Notices of intention to lay a considerable amount of new mains have been published by Louis Hyams, City Recorder, by order of the City Council.

CANADA.

Huntington, P. Q.—Civil Engineer Vanier has laid before the Village Council plans for a water service, etc. His estimate for a steam pump, with building, at the head of the rapids, and water mains along the chief streets, was $61,000. This amount was considered too high by the authorities.

Toronto, Ont.—A 36-in. main is to be laid under the G. T. Ry, at John St.

London, Ont.—The city has voted to raise $70,000 for improving the water supply system, which will include the increasing of the supply by acquiring new springs, new mains, pumping machinery, etc.

Calgary, Manitoba.—The construction of the new works has been commenced. W. H. Cushing, of Calgary, is the contractor.

ARTESIAN WELLS.

Mitchell, S. Dak.—The City Council has decided to advertise for bids for sinking a 6-in. well.

Columbus, Tex.—The City Council has decided to have a well put down.

Abilene, Tex.—The contract for sinking the well has been awarded to a Chicago company, at $13,200.

IRRIGATION.

Culbertson, Neb.—Bonds for $18,000 have been voted to aid in the construction of the Culbertson irrigation and water-power canal.

Nebraska.—The survey for the Mutual irrigation ditch in Scott's Bluff Co. has been completed, and excavation has been commenced.

Cerro, N. M.—It is expected that work on the Taos Valley irrigation canal will soon be commenced. William Aitchison, of St. Louis, Mo., is interested in the project.

Modesto, Cal.—The Board of Directors of the Modesto Irrigation District has purchased the Wheaton dam and all the water rights and claims of M. A. Wheaton upon the Tuolumne River for $21,000. The payment is to be $10,000 cash and $11,000 in district bonds at 90 cts. on the dollar.

Baker City, Ore.—A preliminary survey of the cañon at the head of the Powder River has been made with a view to locating the main reservoir for the water storage system. The point selected for constructing a dam across the cañon is about 20 miles southwest of this city. The dimensions of the dam have not been decided upon, but it will not be less than 120 ft nor more than 200 ft., high, and will form a reservoir six miles long, having a storage capacity of 10,000,000,000 cu. ft. The cañon at this point is about 100 ft. wide. A large number of small reservoirs will also be constructed, and surveys are now being made for the course of the main ditches along the foot-hills.

SEWERAGE AND MUNICIPAL.

Streets.—Salem, N. C., will spend $30,000 on streets.

Rochester, N. Y, will spend $109,500, of which $54,000 will be for asphalt on Emerson St.

At Atlanta, Ga., $1,100 has been appropriated.

At Toronto, Ont., $50,000 has been voted for roadways and $25,000 for sidewalks.

At Louisville, Ky., surveys are being made for a boulevard, the cost of which is estimated at $10,000.

At Madison, Wis., Carroll and Gilman Sts. will be macadamized.

Blaine, Wash., has ordered 6 miles of 12-ft. sidewalk, and 3 miles of street will be graded.

The City Works Dep't of Brooklyn, N. Y., estimates the cost of repairing and laying pavements during the next fiscal year at $300,000.

At Columbus, O., a considerable amount of work is under discussion.

Sewers.—Rochester, N. Y., has voted $12,000 for sewers.

At Atlanta, Ga., an appropriation of $2,400 for sewers has been passed.

A bill appropriating $62,000 for the Marlboro sewerage system has been passed in Boston, Mass., and a special meeting will be held at once in Marlboro to consider the matter.

City Surveyor T. H. McCann, of Hoboken, N. J., has been instructed to prepare a general sewerage plan of the city, working in co-operation with A. Ftely, Chief Eng. of the N. Y. Aqueduct Commission.

A complete system has been designed for Owosso, Mich., by W. R. Coats.

At Kansas City, Mo., an ordinance for 6 miles of sewers at an estimated cost of $45,000 is in preparation.

At Mitchell, S. D, $12,000 will be appropriated.

At Montreal, Can., $15,000 has been voted.

At Troy, N. Y., a number of 3-ft. sewers have been recommended.

At St. Paul, Minn., a $2,000 sewer has been authorized.

Menominee and Iron Mountain, Mich.—Mr. Rudolph Hering is engaged in revising sewer plans. It is expected to begin work this summer.

Mr. W. R. Coats desires us to say that he has not prepared plans for the sewerage of Mobile, Ala., as stated in our last issue.

Bonds.—Winston, N. C., will issue $200,000 of city improvement bonds.

Argentine, Kan., has sold $50,000 of improvement bonds.

Davenport, Ia., will float $75,000 of paving bonds.

West Troy, N. Y., will sell $50,000 of paving bonds.

East Orange, N. J., will sell $25,000 of sewer bonds.

Gas.—The North Carolina Fuel Co. will put in a plant at Asheville, N. C.

The Consumers Gas Co., of Sheridan, Ind., has been incorporated by Pearson Bros. Capital stock, $50,000.

The Rapid City Gas Co. has been incorporated at Chicago, Ill., by F. H. Long, R. H. Broat and P. Brown. Capital stock, $200,000.

ELECTRICAL.

Electric Lighting.—The Binghamton, N. Y., Electric Co. has been incorporated with a capital stock of $200,000.

The Wightman Electric M'f'g Co. has been incorporated at Scranton Pa., with a capital stock of $30,000.

The Wenstrom Consolidated Dynamo & Motor Co. will put up works at Calverton, Md., occupying nearly 12 acres.

The Volta Electric Battery Co. has been incorporated at Baltimore, Md., by E. Sutherland, T. E. Hambleton, and W. H. Bayless Capital stock, $300,000.

The Occidental Co., of Tarpon Springs, Fla., will put in a plant.

The Monitor Electric Co., of Chicago, Ill., has been incorporated by G. A. Harmount, N. Campbell, and J. Grant. Capital stock, $50,000.

The Quincy, Ill., Electric Light Co. has been incorporated by F. C. Crowley, W. C. Baine, and M. Pickett. Capital stock, $400,000.

The Peoria, Ill., Gas & Electric Light Co. has been incorporated by F. C. Crowley, W. C. Baine, and M. Pickett. Capital stock, $750,000.

The Worrell Electric Construction Co. has been incorporated in Chicago, Ill., by C. E. Gaylord, M. J. Frost and C. Y. White. Capital stock, $500,000.

Lights will be introduced into Cairo, Ill.

Macon, Mo., has voted to establish an electric light plant.

The Kalamazoo, Mich., plant is to be increased by 4,000 incandescent lamps.

Denver, Colo., will hereafter pay but $10 per month for each lamp of 2,000 candle power, just half of what was formerly paid.

The Blaine, Wash., Electric Light & Power Co. has been organized with a capital stock of $50,000.

Shelton, Wash., will probably buy a plant soon.

Underground Wires.—All telephone wires at Atlanta, Ga., are to be laid under ground. The telephone company promises to finish the work in 3 years.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Montreal, P. Q.*—The plans have been prepared for the proposed bridge across St. Catherine St. The structure is 586 ft. long, 60 ft. wide, and will cost $80,000.

Bridgeport, Conn.—A bridge to cost $90,000 will be built across the Housatonic River at this place.

Rochester, N. Y.—Bids are asked for the construction of a lift bridge over the Erie Canal. Edward Hannan, Superintendent of Public Works, Albany, N. Y.

Lynchburg, Va.—The Edge Moor Bridge Co., of Wilmington, Del., has the contract for building the Rivermont bridge at this place. The contract price was $68,515.

Wheeling, W. Va.—Cribs Nos. 1 and 2 for the Black River bridge have been sunk and as soon as one more is put down the work of building the piers will begin. The foundation for the Ohio side abutment is completed and ready for stone. The work is progressing very rapidly.

Wheeling, W. Va.—The Wheeling & Bridgeport Bridge Co. has been organized with a capital of $300,000. It is a branch of the Wheeling Bridge Co., now constructing two bridges between this city and Martin's Ferry. The new concern will put up a third bridge and 10 miles of street car line are to be built connecting them on the Ohio side; $1,500,000 will be expended in the enterprise.

Chesterfield, Ill.—An iron bridge will be built across Macoupin Creek at this place.

Duluth, Minn.—The plans and specifications for the proposed canal bridge have been received and bids for the work will be received up to July 1.

Minneapolis, Minn.—It is reported that the Millers' Belt Line Co. has completed plans for a bridge across the river between Tenth Ave. south and the Northern Pacific bridge, which is to be used exclusively for belt line business. The required land has been secured on each shore of the river, and work will be commenced soon.

Shawnee Co., Kan.—Bids will be received until July 17 for building the following bridges:

A combination bridge over Wakarusa Creek on the Topeka and Carbondale road, in Williamsport township. Length of span, 100 ft. with two 16-ft approaches. Width of roadway, 16 ft. in the clear, to rest on oak pile substructure.—A 30-ft. combination bridge with one 16-ft. approach, on oak pile substructure, and 16 ft. roadway, over Berry Creek in Monmouth township.—A 30-ft. combination bridge with oak pile substructure, and 16 ft. roadway, on Young road, in Williamsport township.—A 50-ft. iron bridge on iron tubular piers, with 16-ft. roadway, on the Max Henry road, in Topeka township.—A 30-ft. combination bridge with oak pile substructure and 16-ft. roadway, over Disney branch on the Costa road, in Monmouth township.—A stone arch bridge, two spans of 30 ft. each, across Mission Creek, Dover township. Address J. M. Brown, County Clerk.

Clackamas Co., Ore.—Bids will be received until July 9 for the construction of a bridge across the Tualatin River. H. H. Johnson, County Clerk.

Canals.—The surveyors have completed the detailed survey of the water-power canal, which will tap the Frenchman River about three miles above Palisade, Hitchcock Co., Neb., and empty into the Republican River, at McCook. The canal will be about 30 miles long. E. H. Kellogg, of Denver, has charge of the surveying party and will have complete estimates made by July 1.

A company is to be organized to construct a canal near Weldon, Miss. L. B. Gilbert, of Weldon, is interested.

Tunnels.—Attention is called to an advertisement in another column by The Cataract Construction Co., of New York, inviting proposals until July 19 for constructing 8 000 ft. of tunnel, more or less, with cross-section about 18 by 19 ft., of the Niagara Falls (N. Y.) Power Co. Contractors will be expected to personally inspect the site before making proposals. For form of contract, proposal and information apply, after June 28, to Albert H. Porter Engineer, Niagara Falls.

CONTRACTING.

Lamps.—Baltimore, Md. J. Conway was awarded the contract for lamps at $2.90 each, and J. J. Lacy & Co. that for lamp pillars at $3.50 each.

Buildings.—Spokane Falls, Wash.; the Northern Pacific station will be built by Decks & Wilber, of St. Paul, for $45,000. It is to be of pressed brick with brownstone trimmings, 100 by 50 ft.

Santa Rosa, Cal.; a jail will be erected at a cost of $40,000.

Big Tunnel Contract.—D. Shanahan & Co., Louisville, Ky., have been awarded the contract for constructing the Busk Tunnel on the Colorado Midland Ry. It will be 9,350 ft. long. The amount of the contract price is about $1,000,000. B. H. Bryant, Colorado Springs, Col., is the chief engineer of the railroad, and has been in New York for the past fortnight attending to the details of the contract letting.

Practice Cruiser.—S. I. Moore & Co., Elizabethport, N. J., have been awarded the contract for the steel cruiser for the Naval Academy. Their bid was $250,000, $5,000 more than that of F. W. Wheeler, West Bay City, Mich., who was refused the contract on account of the treaty with England forbidding the building or maintenance of more than one war vessel on the Great Lakes.

Sewers.—Superior, Minn.; Youngren & Abbott have been awarded the Butler Ave. sewer; their bid was $54,431.

Brooklyn, N. Y.; contracts have been awarded as follows: H. Bogert, 36-in. brick sewer on grillage, $11 per running foot; 36-in. brick sewer on cradle, $7 per running foot; each manhole complete, $41; each street basin complete, $120. Harris & Maguire, 36-in brick sewer on cradle, $10.15 per running foot; 36 in. brick sewer on cradle, $6.36 per running foot; each manhole complete, $40; each street basin complete, $120. E. Gorman, 36-in. brick sewer on grillage, $5 per running foot; 36-in. brick sewer on cradle, $3.80 per running foot; each manhole complete, $31; each street basin complete, $99.

New Rochelle, N. Y.—The following bids for the construction of sewers and drains were received by Horace Crosby, Civil Engineer. June 14, 1890.

Bidders.	Residence.	15-in. pipe. Lin. ft.	12-in. pipe. Lin. ft.	10-in. pipe. Lin. ft.	8-in. pipe. Lin. ft.	6-in. pipe. Lin. ft.	5-in. house connections. Lin. ft.	Y's each.	Rock. Cu. yd.	Concrete. Cu. yd.	Broken stone. Cu. yd.	Manholes.	Flush tanks.	Lamp holes.	Other items.	Total.
		$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Wm. F. Croft	New Rochelle.	1.25	1.15	1.50	1.03	0.83	0.83½	1.00	3.17	6.00	1.00	40	65	15	2,208	46,237
Molloy Bros	New Rochelle.	1.40	1.21	0.91	0.75	0.65	0.57	0.30	3.00	3.75	0.90	40	75	12	1,664	39,745
Van Vranken & Duell	Schnectady	1.02	0.98	1.32	0.82	0.53	0.43	0.41	2.47	5.00	2.00	45	60	8	2,905	38,073
Geo. E. Clark	New York City	1.25	1.20	1.10	0.95	0.70	0.60	0.72	3.50	6 00	2.25	50	75	15	1,827	46,985
M. J. Leahy	New York City	2.20	1.65	1.65	1.65	1.62	0.70	1.55	2.25	3.50	1.60	75	80	10	2,119	56,444
J. H. Edwards	New York City	1.60	2.20	1 10	0.90	0.72	0.42	0.50½	3.95	6.00	1.10	55	100	5	2,366	250,73
J. H. & J. R. Byron	Mount Vernon	1.23	1.20	1.29	0.93	0.79½	0.40	0.50	3.25	5.00	2.25	50	75	18	1,904	45,664
Fogg & Scribner	New York City	1.50	1.35	1.00	0.87	0 75	0.60	1.00	2.40	5.00	1.50	50	80	15	1,526	41,086
Frank B. Bertram	New York City	Informal—Withdrawn.														

Contract awarded to Molloy Bros.

Streets.—Union Co., N. J.; the contract for macadamizing Westfield Ave., given to E. H. Lynch, of Elizabeth, at 83 cts. per sq. yd.

St. Paul, Minn.; contract for grading Pacific St., awarded to T. Sweeny, whose bid of $5,625 was $805 below the engineer's estimate.

Washington, D. C.; the following bids have been received for improving Brightwood Ave.: M. J. Fahy, removing old rubble, 10 cts. per sq. yd.; grading, 35 cts. per cu. yd.; hauling earth per 100 ft. over 500 ft. ¼ ct. per cu. yd.; setting curb, 15 cts. per ft.; furnishing and laying granite pavement, $2.85 per sq. yd. M. F. Talty, removing old rubble, 15 cts. per sq. yd.; grading, 40 cts. per sq. yd; hauling earth, 1 ct. per cu. yd.; setting curb, 22 cts. per ft.; furnishing and laying granite pavement, $2.90 per sq. ft. W. H. Mobler, removing old rubble, 13 cts. per sq. yd.; grading, 31 cts. per cu. yd.; hauling earth, ¾ ct. per ft.; furnishing and laying granite pavement, $2.75.

Detroit, Mich.; the lowest bids received for paving Napoleon St. were: for sand with plank foundation, $1.25 per sq. yd.; for concrete, $1.75 per sq. yd.

PROPOSALS OPEN.

Paving.—12,500 sq. yds. with fire brick. R. F. Allender, Martin's Ferry, O. July 3.

J. J. Adams, Brooklyn, N. Y. July 1 and 7.

E. M. Bigelow, Pittsburg, Pa. July 2.

L. G. Walker, Chattanooga, Tenn. July 10.

Sewers.—C. G. Force, Cleveland, O. July 10.

W. M. Dunlap, Roanoke, Va July 7.

E. C. Ross, Troy, N. Y. July 1.

About 4,000 ft. D. C. Barrrow, Athens, Ga. July 20.

Granite Blocks.—G. Alexander, Quincy, Ill. July 5.

J. J. Adams, Brooklyn, N. Y. July 1.

Jails.—M. S. Ellsworth, Wheaton, Ill. July 12.

J. S. Tooker, Helena, Mont. July 2.

Courthouse.—C. E. Smith, Throckmorton, Tex. July 7.

Gravel Road.—Major Scully, Atlanta, Ga. July 14.

Sidewalk.—F. B. Crocker, Denver, Col. July 12.

Piers.—For drawbridge. M. Bunnell, Duluth, Minn. July 2.

Of wood, in Harlem River. Dock Dep't, New York, N. Y. July 7.

Cement.—J. W. Douglass, Washington, D. C. July 10.

Bridge.—Iron, steel or combination through highway bridge, span 140 ft. F. J. Reinhard, Franklin County, O. July 17.

Iron Work.—For Congressional Library. B. R. Green, Washington, D. C., July 3.

Dredging.—At Navy Yard, Brooklyn, N. Y. N. H. Farquhar, Navy Dep't., Washington, D. C., July 2.

Dike.—In Delaware River. C. W. Raymond, 1428 Arch St., Philadelphia, Pa. July 17.

Terra Cotta Pipe.—J. W. Douglass, Washington, D.C., July 10.

Copper Pipe.—For Mare Island Navy Yard. E. Stewart, Navy Dep't., Washington, D. C., July 15.

Granite.—For river wall. Dep't of Docks, New York, July 3.

Canal Work.—About 32,800 cu. yds. excavation, 21,160 cu. yds. embankment, 18,000 cu. yds. masonry. E. Hannon, Albany, N. Y. July 8.

Dredging.—About 34,000 cu. yds. E. Hannan, Albany, N. Y. July 1.

Cast-iron Pipe.—J. W. Douglass, Washington, D. C. July 5.

Cement.—550 bbls. Water Board, Boston, Mass. July 1.

Grading.—300,000 cu. yds. W. N. Babcock, South Omaha, Neb. July 1.

Stone Culvert.—E. Hannan, Albany, N. Y. July 1.

Low Service Conduit.—G. Burnet, St. Louis, Mo. July 8.

Lift Bridge.—Over Erie Canal. E. Hannan, Albany, N. Y. July 1.

Pier.—New center pier for Meeker Ave. Bridge. Board Supervisors of Kings County, Brooklyn N. Y. June 30.

Pumping Engines.—Two engines to work at 125 lbs pressure and a speed not exceeding 24 strokes a minute. Water Commissioner, St. Louis, Mo. July 15.

MANUFACTURING AND TECHNICAL.

Road Roller.—The Harrisburg Machine Co., Harrisburg, Pa., will send a roller to Omeyville, R. I.

Two of Aveling & Porter's steam road-rollers have lately been put to work at Shanghai, China, and the consternation and amazement of the natives were intense. A good deal of road work is projected, and the construction of the pavement is placed in the hands of European engineers.

Locomotives.—The Manchester, N. H., Locomotive Works have finished an engine for the Concord & Montreal Ry.

The Schenectady Locomotive Works have sent two engines to the Tennessee, Virginia & Georgia Ry.

The Pittsburg, Akron & Western Ry. has ordered 13 large 10-wheel locomotives from the Pittsburg Locomotive Works.

The Pittsburg Locomotive Works are now turning out 10 or 12 locomotives a month, and when the present improvements are complete will have a capacity of 20 or 25 a month.

Among the orders recently completed are 10 consolidated locomotives for the Pennsylvania Ry. These have 20 x 24-in. cylinders and weigh 106,000 lbs.

The Montgomery, Tuscaloosa & Memphis Ry. has recently received eight locomotives from the Brooks Locomotive Works.

The Lake Shore & Michigan Southern Ry. has received 20 10-wheel locomotives from the Brooks Locomotive Works, Dunkirk, N. Y., and 5 6-wheel switching engines from the Rogers Locomotive Works, of Paterson, N. J.

The Manhattan Elevated Ry., New York, has invited bids on 50 engines weighing 23½ tons, to replace a similar number of lighter engines now in service.

The 10-wheel express engines which the Baldwin Locomotive Works built for the Baltimore & Ohio Ry. were guaranteed to haul 7 passenger coaches up a 117-ft. grade 17 miles long at 25 miles an hour. The one which has been put in service has more than met the guarantee, hauling with ease 8 loaded coaches up this grade at the required speed. With these engines the weight on the drivers is 102,000 lbs. The total weight of the engine, with out tank, is 133,000 lbs.

Cars.—The Port Townsend Southern Ry. have bought a number of flat cars.

The Minneapolis, Minn., electric lines have bought 10 cars.

The Charleston, Sumter & Northern Ry. is reported to have invited bids for the construction of about 400 freight cars.

Armour & Co., of Chicago, will build 200 refrigerator cars.

The Atchison, Topeka & Santa Fé Ry. is building several passenger cars at its Topeka shops.

The Elliott Car Works, of Gadsden, Ala., have delivered 100 Tomlinsons patent dump-cars to the Alabama Southern Ry. The same firm is working on 40 ore cars for the East & West Ry. of Alabama.

Car Wheels.—The Milwaukee, Wis., Car Wheel & Foundry Co. has increased its capital stock to $200,000.

The Union Pacific R. R. has ordered wheels for 100 engines from the Allen Paper Car Wheel Co., 31 Broadway, New York. The wheels are to be of the "Allen No. 9" pattern with the Krupp open-hearth tire.

All the steel tires to be used during the coming year on the Georgia Ry, the Atlantic Coast Line and the Mexican National Ry., will be supplied by B. D. Hasseli & Co., of New York.

Car Works.—The Ensign Manufacturing Co, Huntington, W. Va., will erect a new foundry at its car works.

Derricks.—The Cram patent derrick has given such satisfaction on the Boston, Mass., water works that four more have been ordered.

The Hyatt Pure Water Co., of New York, has sold a filtering plant of 2,000,000 galls, daily capacity to Beaver Falls, Pa., and a plant of 1,000,000 galls. capacity to St. Thomas, Ont.

Harbor Work.—The Sigua Iron Co., Bullitt Building, Philadelphia, proposes to build 8 miles of railroad, and a harbor at Segua, Cuba. They are looking for a contractor who has a large plant, financial ability, and experience in harbor work on the seaboard, and who can also take the contract for the railroad to their mines.

The Haskin Wood Vulcanizing Company has been incorporated under the Laws of the State of New York. Capital, $5,000,000. The officers are: President, Dan P. Ellis; Vice-President, Edgar Tucker; Secretary, James R. Dunn; Treasurer, Harry S. Stevens; General Manager, Samuel E. Haskin. Offices at No. 40 Wall St., New York.

Dry Dock.—The keelstone of the first dry dock on the Great Lakes was laid at Kingston, Ont., June 19.

Asphalt.—The Buffalo Paving Co. has been incorporated at Albany, N. Y., by J. B. Manning, A. F. West and G. Sandrock. The company will use Kentucky rock asphalt, which they claim to be equal to the best French products.

Steel and Iron Works.—The new stock house of the Isabella furnace at Barneston, Pa., will be 54 by 100 ft., so arranged that loaded trains can pass through the building. The Berlin Iron Bridge Co. has the contract.

Iron plate mills are to be erected at Roanoke, Va.

At Graham, Va., a steel plant is proposed. The Graham Land & Improvement Co. can give information.

The Industrial Iron Works have been incorporated at Kansas City, Mo., by J. H. Burton, C. A. Burton and T H. Adams.

The Baltimore & Ohio Ry. will remove its machine shops at Piedmont and Martinsburg, W. Va., and Connellsville, Pa., to Cumberland, Md.

Track Tanks.—The Philadelphia & Reading Ry. has begun work on the new tanks at Trenton Junction. They will be 1,500 ft. long, placed in each track, and provided with steam heating pipes.

The Pan-Handle lines of the Pennsylvania system will put in a number of tanks.

A Pneumatic Clock Regulating System is in operation at Aldrich Court, New York City. Each clock in the system is connected by small tubes with the central station, and is regulated every hour.

Oil Purifier.—In last weeks issue we described and illustrated a lubricating oil purifier, but gave an incorrect address of the manufacturers, which should be Grosche & Bigler, 36 Vesey St., New York.

Filters.—The Hyatt Pure Water Co., New York, has closed contracts for Filter plants with the Cleveland Rolling Mills, Cleveland, O.; Robinson Brewing Co., Scranton, Pa.; Dewees Wood Co., Pittsburg, Pa.; Liebler Bottling Co., New York; Creedmore Beer Co., Brooklyn, N. Y.; Chemung Canal Bottling Co., Elmira, N. Y.; Brough Mineral Water Co, Cleveland, O.

The Waterbury Malleable Iron Co., of Waterbury, Conn., was sold June 19 by E. de F. Shelton, New York, for $20,000.

Metal Market Prices.—*Rails*—New York: $31 to $31.50; for old iron rails, $24.50 to $25.75. Chicago: $34 to 35; old rails, $25.75 to $26 for iron, $18 to $21.50 for steel. Pittsburg: $31.50 to $32.50; old rails, $26.50 to $27 for iron, $21 to $22.50 for steel.

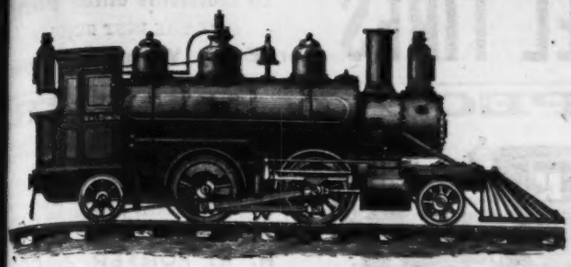
Foundry Pig-iron.—Chicago: $15 to $17. Pittsburg, $14.50 to $18. New York: $16 to $18.50.

Track Materials.—New York: steel angle bars, 1.8 to 1.9 cts.; spikes, $2.05 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron; spikes, 2.15; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.10 to 2.15 cts. for steel, and 1.95 to 2 cts. for iron; spikes, $2.00; track bolts, 3 cts., with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.35 cts.; Chicago, 4.3 to 4.5 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.75 cts.; universal mill plates, 2.40 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for firebox; 3.15 to 3.20 cts for flange; 3 cts. for shell, 2.75 cts. for tank. New York: beams, 3.10 cts., plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts.



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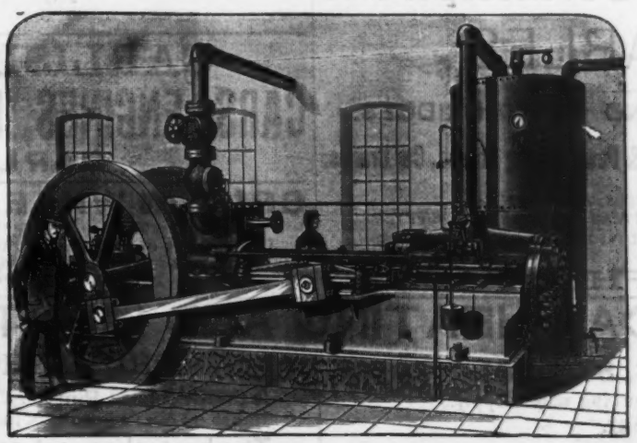

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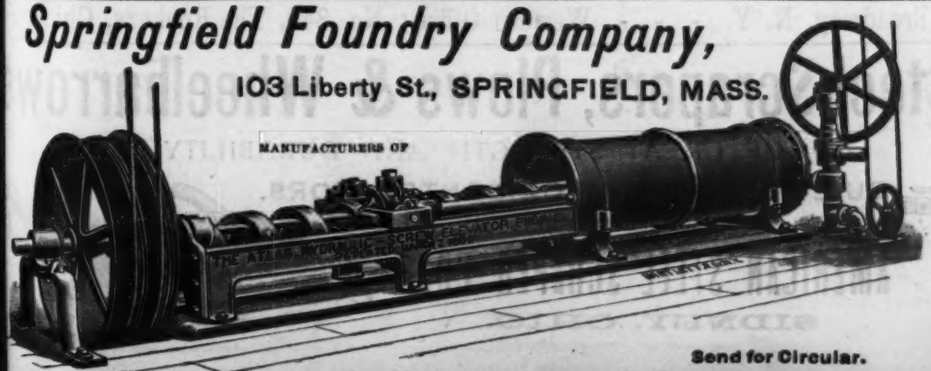

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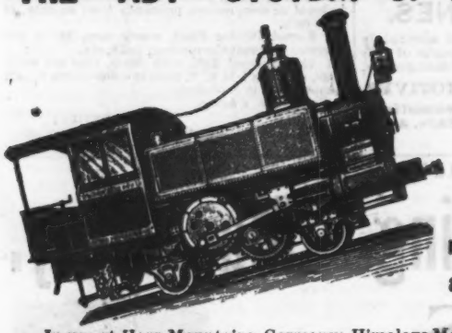

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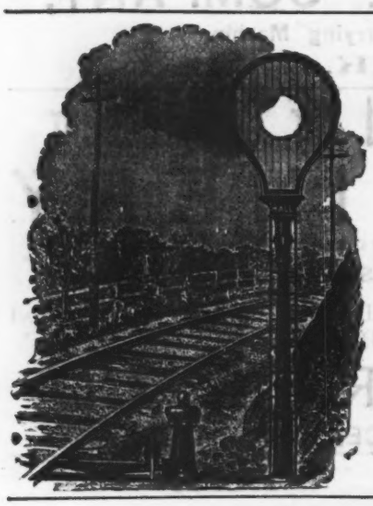

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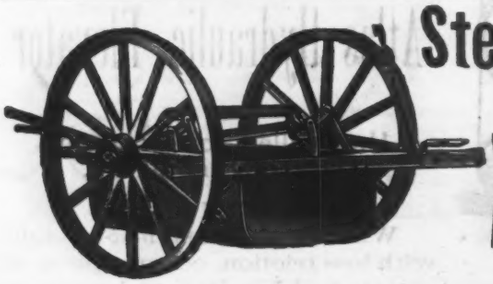

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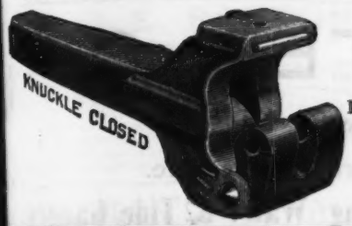

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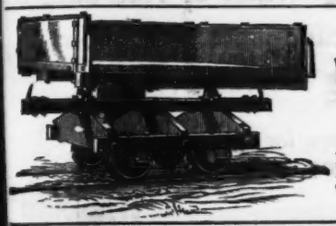

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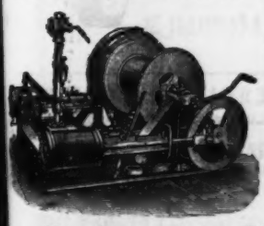

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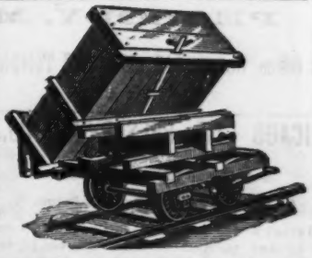

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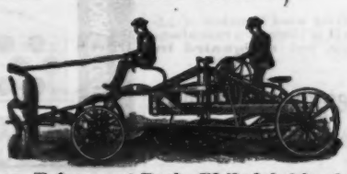

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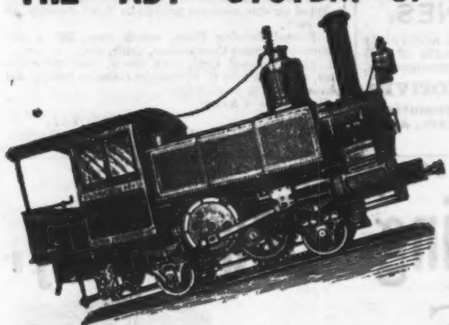

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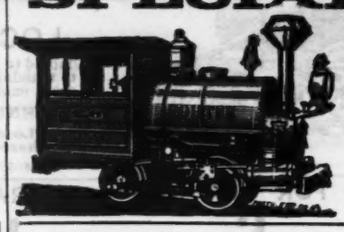

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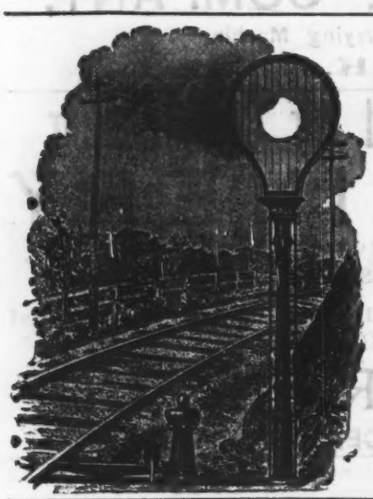

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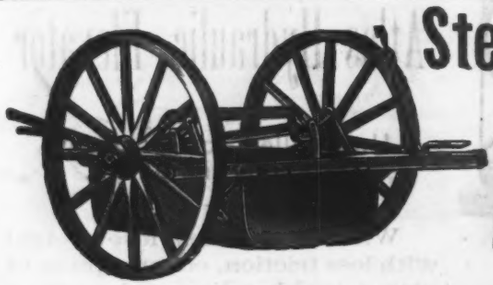

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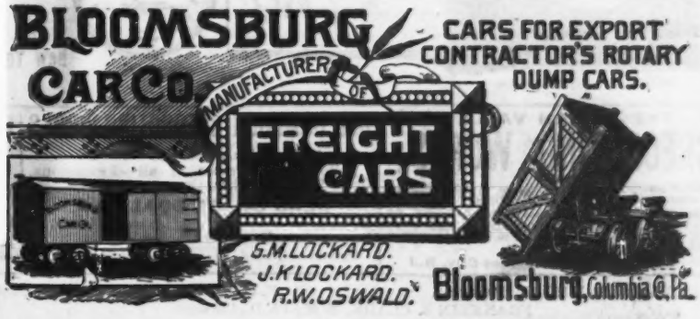

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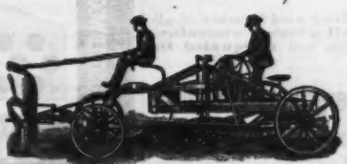

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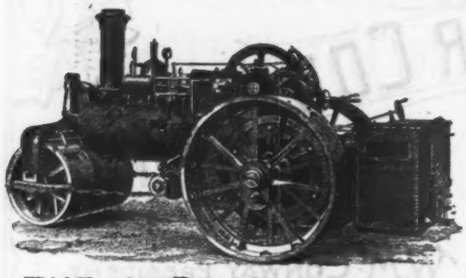

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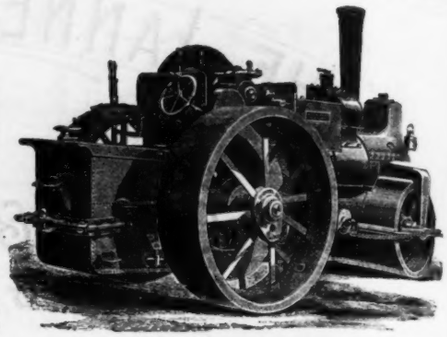

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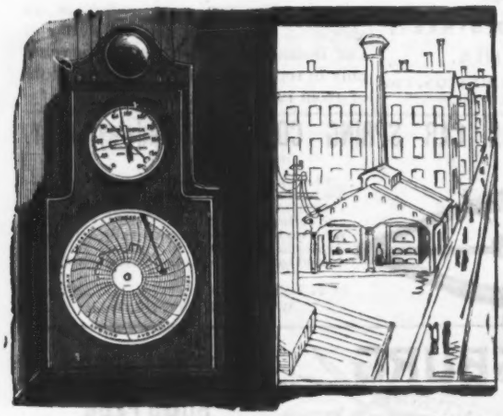

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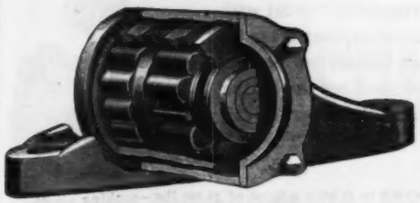

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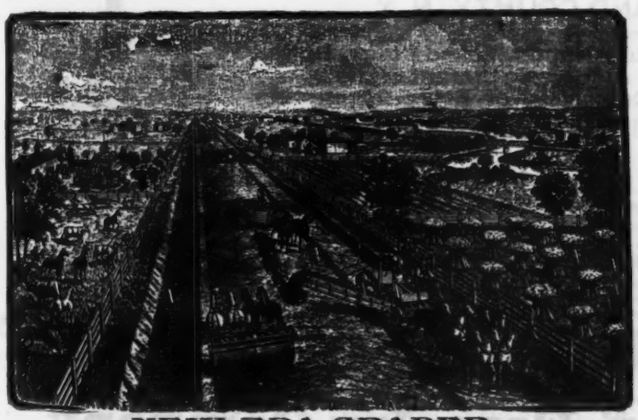

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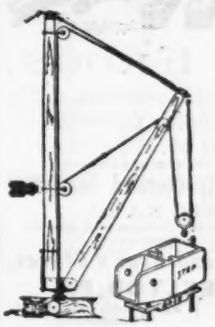

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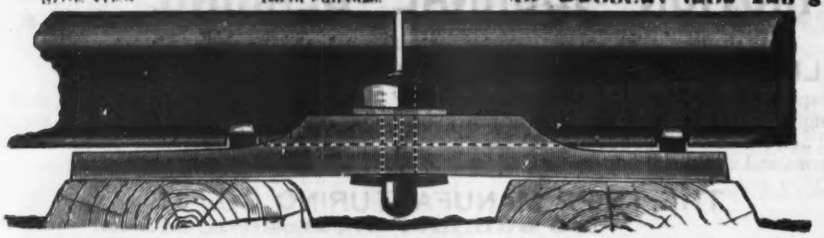

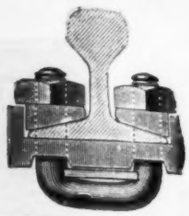

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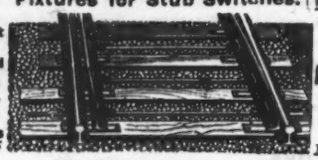

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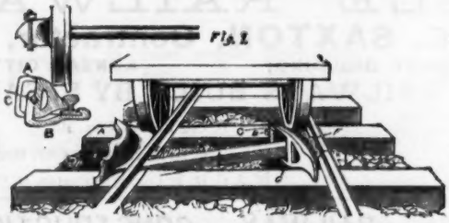

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1882	1085	1190
1883	4966	6156
1884	15051	21207
1885	10410	31617
1886	8946	40563
1887	9281	49844
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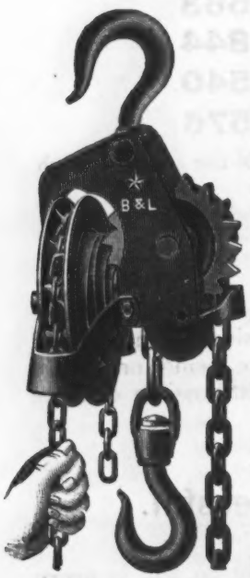

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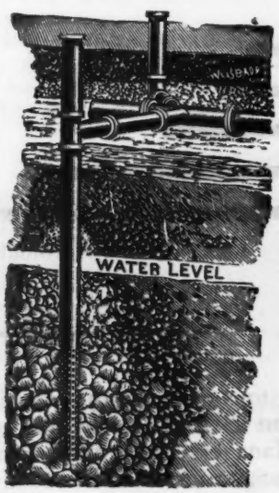

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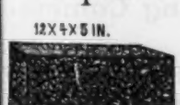

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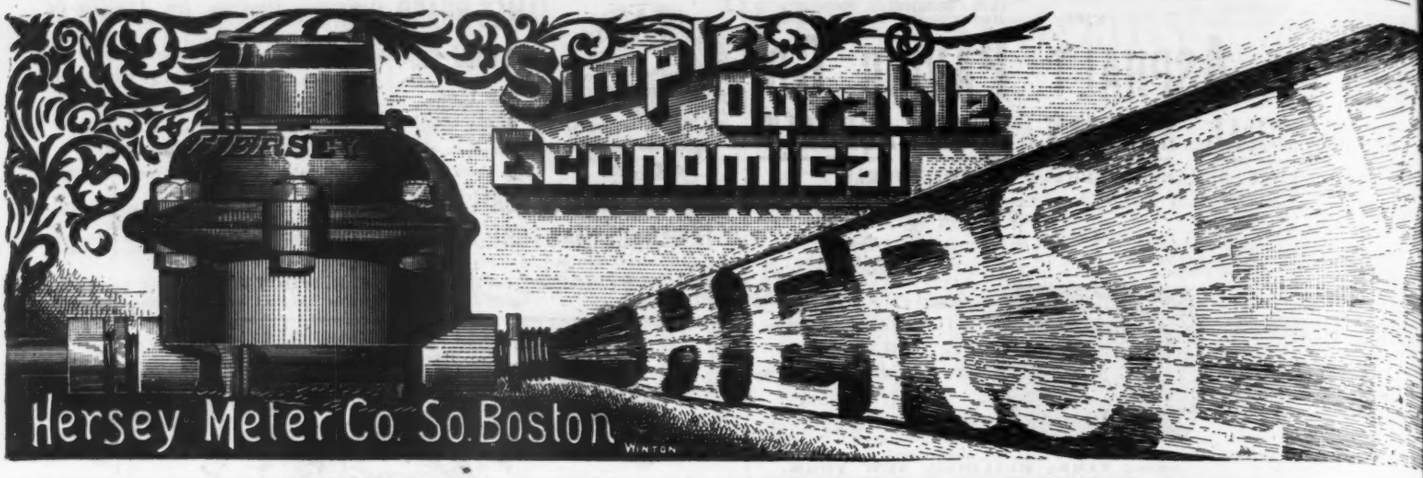

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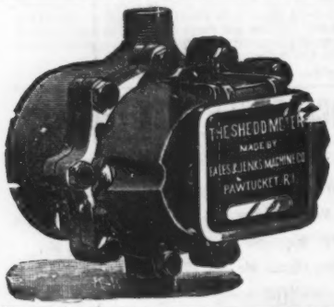

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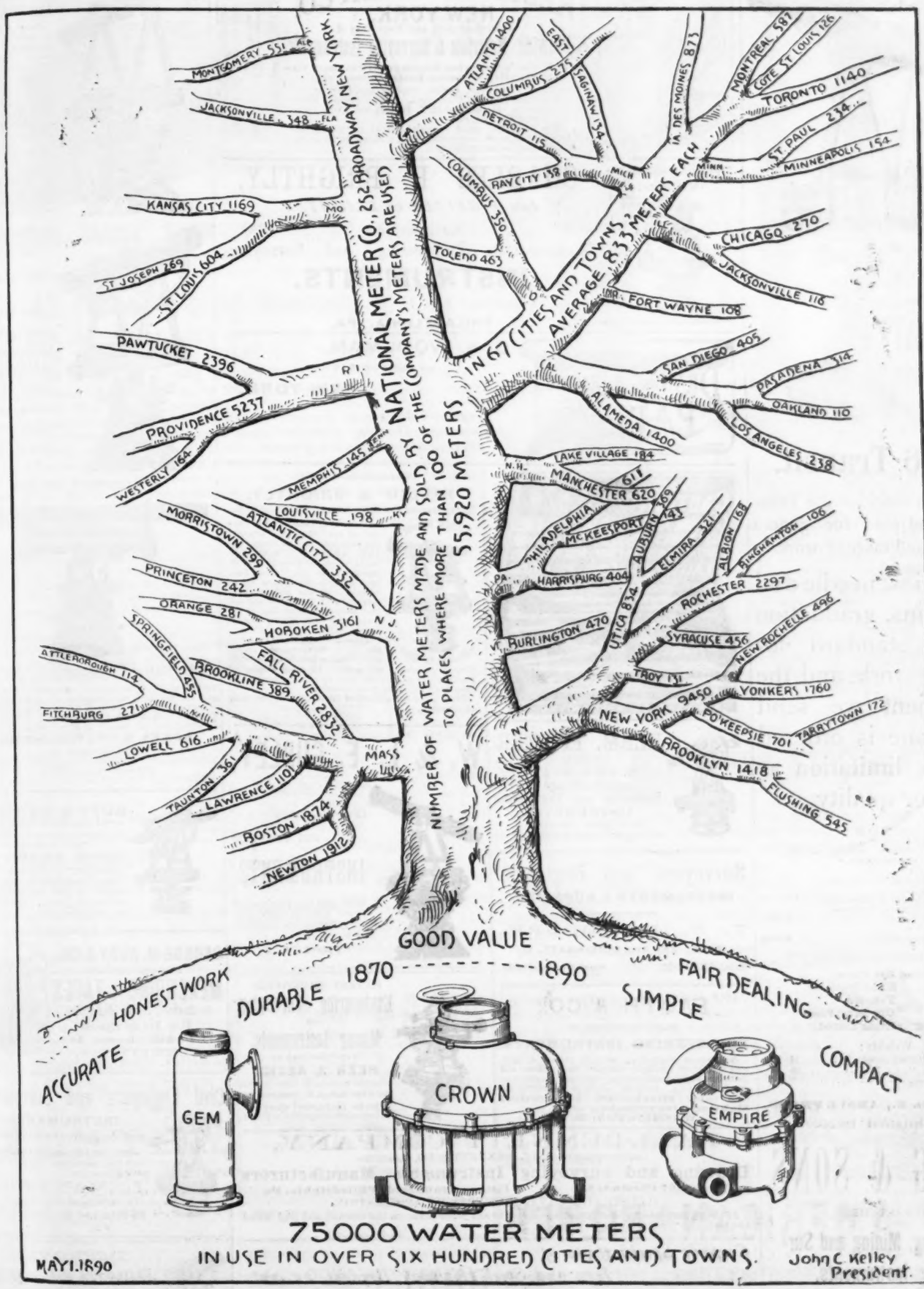
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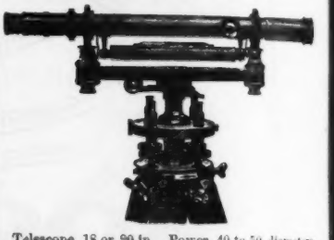

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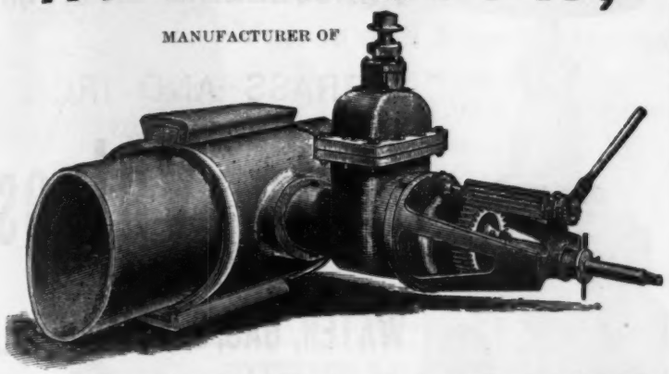

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Forms of proposals, copies of specifications, plans and profiles on file at the City Clerk's office. Each bid must contain the full name of every person interested in the bid, and shall be accompanied by a sufficient guaranty of some disinterested person in the sum of $5,000, that if the bid is accepted a contract will be entered into, and its performance properly secured.

The prices for labor and material shall be separately stated.

The right is reserved to reject any or all bids.

MARION, O., June 16, 1890.

H. S. JONES, City Engineer. CHAS. W. LEFFLER, Chairman Sewer Committee.

25-4t.

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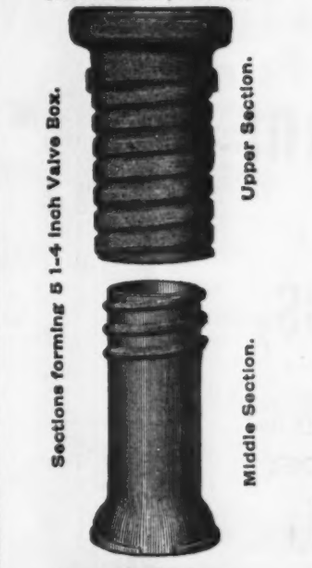

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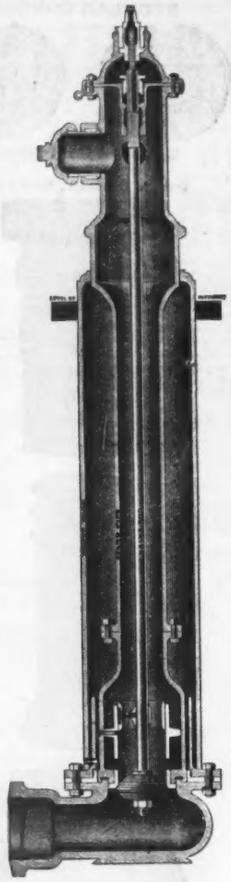

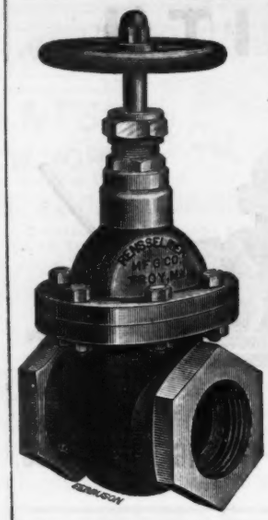

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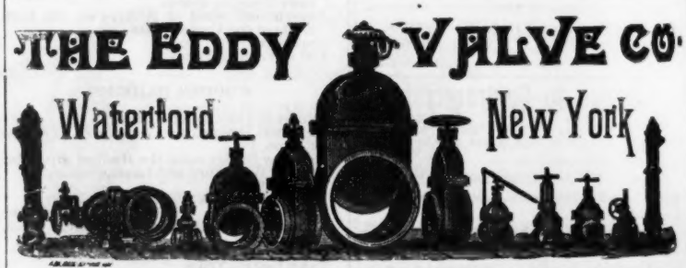
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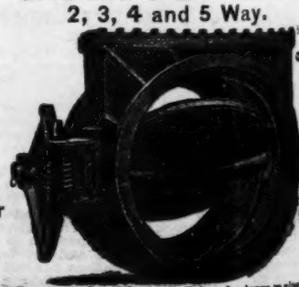
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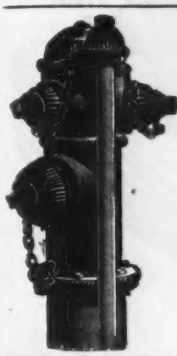

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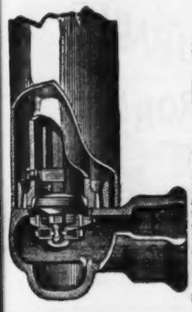

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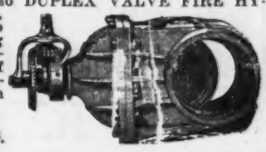

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CONICAL COMPOUND WEDGE GATE HYDRANT.
VALVES
FOR WATER, STEAM, GAS AND OIL.
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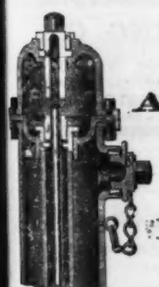

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Unexcelled for simplicity of construction, durability and low cost of maintenance.
All wearing surfaces of composition, drips below the main and cannot freeze.
Stones or gravel will not clog it.

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The only magnetic oxide process for rendering all classes of iron work *Rustless*. For licenses and information apply at the Company's office, 31 Nassau St., New York.

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20 Hoisting Engines—Various Sizes.
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58 Contractor's Cars, 30-in. gauge.

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INVESTIGATE the merits of the Reliance Safety Water Columns. It pays to keep posted. Many of the large corporations have found it profitable to discard the old appliances and adopt these safe guards. There is always economy in safety. Send for illustrated price list.
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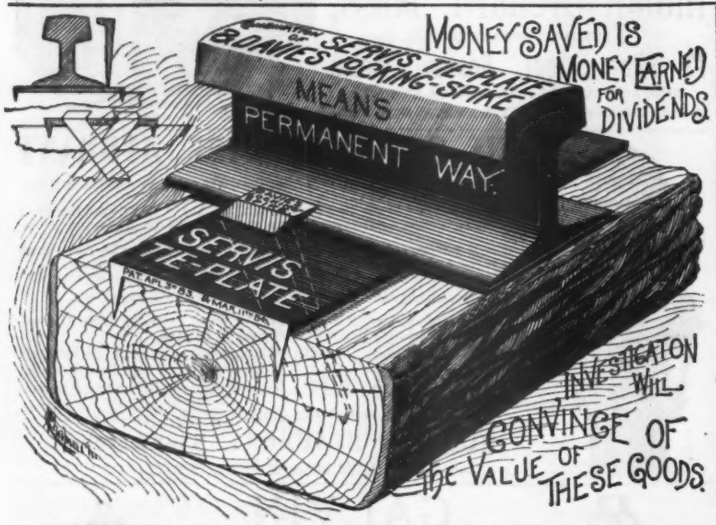

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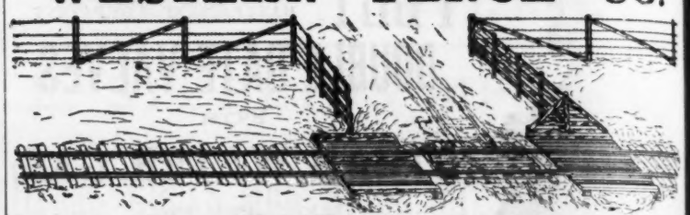

Contract to fence Railways with Barbed Wire, complete with Gates, Wings and Cattle Guard Fence. Materials and construction guaranteed. Send for full particulars.

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SIMPLE, RELIABLE, COMPACT, DURABLE.

NO OUTSIDE VALVE GEAR. ADAPTED FOR ALL PURPOSES.

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The meaning of the word advertise, "to make known," explains its importance. Make known what you have to sell or what you wish to buy. The benefits are so far-reaching that you cannot tell where they will end. Like the ripples of water caused by a stone, they extend far beyond the sight.—*Keokuk (Ia. Gate City.*

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ASBESTOS MATERIALS.

Asbestos Millboard—Flat Packing, composed wholly of pure Asbestos, and weighs 20 per cent. less than adulterated Millboard.

Asbestos Piston Rod Packing.—The most durable and easily applied. Indestructible by acids or any degree of heat.

Asbestos Cloth, Cord, Twine and Sewing Twine, Asbestos Building Felt and Sheathings.

Vulcabeston, for electrical plates, rings, washers, sheet packing, accumulator cells, etc.

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Sole Manufacturers of H. W. Johns' Asbestos Steam Packings, Boiler Coverings, Liquid Paints, Roof Paints, Roof Cement, Fire-Proof Paints, etc.

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ALUMINUM, $2 PER POUND.

The Pittsburg Reduction Company, 95 Fifth Ave., Pittsburg, Pa., U. S. A., offer commercially pure aluminum at the following rates at Pittsburg, Pa.:
Lots of 1,000 lbs. and over, $2 per lb.; lots of 500 lbs. and over, $2.25 per lb.; lots of 100 lbs. and over, $2.50 per lb. Metal guaranteed to be equal in quality to the best metal manufactured by any other process.

THE ADDYSTON PIPE & STEEL Co.

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Specialty: Pipes for Natural Gas and Fuel Gas.

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"Without doubt it has proved itself to be the most useful hand book in the language for the engineering profession."—*Engineering and Mining Journal*, Aug. 25, 1888.

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By W. WILLCOCKS, with introduction by Lieut.-Col. J. C. Ross. Being a physical description of Egypt, with particulars of various methods of Irrigation and Drainage, and full details of Engineering Construction. 367 pages with 26 plates and 69 engravings, 4to, cloth, price $15, by mail or express. Circulars and Catalogues on application.
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Adopted in 1887 by more than 100 Towns and Cities.
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M. J. DRUMMOND, Sales Agent, 192 Broadway, N. Y. City

CLINTON WIRE CLOTH CO.,

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PERFORATED METALS,

For MINING MACHINERY and ALL OTHER USES.

WIRE CLOTH.

Factory: Clinton, Mass. NEW YORK: 76 Beekman St BOSTON: 23 Court St. CHICAGO: 147 Lake St.

Water-Works.

Sealed proposals will be received by the President and Board of Trustees of Imlay City, Mich., until 1 P. M., Friday, July 11, 1890, for the construction of a system of water-works, according to plans and specifications for the same, which may be seen at the office of the village clerk of said village, on and after June 27, or at the office of the engineer, Geo. Cadogan Morgan, 15 Major Block, Chicago. All proposals must be sealed and marked "Proposal for Water-Works," and must be filed with the village clerk of said village on or before the time stated.

Each proposal must be accompanied with a clearing house check, made payable to the village treasurer of said village as a guarantee of good faith, for the sum of $250, the same to be returned when proposal is rejected or accepted, and a satisfactory bond deposited with the board of trustees.

The Board of Trustees reserves the right to make any additions to or deductions from the accepted proposal to the amount of 15 per cent. of the same any time before goods are ordered or work done on all or any part of the work, and still further reserves the right to reject any and all bids.

(Signed), CHAS. S. MARSHALL, President.

E. F. PALMER, T. B. KEYWORTH, WM. A. SLEEMAN, } Committee on Water-Works.

26-1t

Notice to Contractors.

OFFICE BOARD OF PUBLIC WORKS, CHATTANOOGA, Tenn., June 20, 1890.

Sealed proposals, directed to the undersigned, will be received at this office until 12 o'clock, noon, Thursday, July 10, 1890, for paving about six (6) miles of streets in this city. Bids are invited for paving certain streets with either Trinidad sheet asphalt, compressed asphalt blocks or bricks; and on certain streets for Trinidad sheet asphalt only, for granite block pavement only, and for brick pavement only.

For forms for proposals, specifications, and further information apply or write to the undersigned.

The right is reserved to reject any or all bids.

By order of the Board of Public Works.

26-1t L. G. WALKER, Chairman.

SEALED PROPOSALS in triplicate, for removing and rebuilding of superstructure (1,470 ft.) of breakwater at Oswego, N. Y., will be received at this office until 12 o'clock noon, July 17, 1890, and then publicly opened. Attention is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. XXIII., page 332, and Vol. XXIV., page 414, Statutes at Large. Detailed information on application to U. S. Engineer Office, Oswego, N. Y. 25-2t—28-1t

IMPROVEMENT OF DELAWARE RIVER. U. S. Engineer Office, 1,428 Arch street, Philadelphia, Pa., June 16, 1890. Sealed proposals in duplicate will be received at this office until 11 a. m., Thursday, July 17, 1890, and then opened, for constructing a pile and stone dike at Bulkhead Bar. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. XXIII., page 332, and Vol. XXIV., page 414, Statutes at Large. For all information apply to C. W. Raymond, Major of Engineers, U. S. Army. 25-4t

Highway Contractors.

The Street Committee of the City of Danbury will receive proposals for macadamizing and block pavement until July 1, 1890. Specifications and etc., furnished on application to the COMMITTEE ON STREETS, Danbury, Ct.

Water-Works.

Sealed proposals for the construction and operation of a system of water works on the franchise plan, to run for 20 years, city taking 55 hydrants. Bids received until July 13, 1890. Address A. M. PARSONS, Chairman, 24-3t Box 159, Somerset, Ky.

Water-Works Contractors.

THE

Hughesville Water Company,

of Hughesville, Pa., are about to build a gravity water works plant, consisting of a masonry dam, about 4¼ miles of cast-iron main pipe, with intersections to supply the towns of Hughesville and Picture Rocks, fire-plugs, etc., for public use. Contractors are invited to write for plans and specifications and bid upon the work, the company reserving the right to reject any or all bids. Address all communications to the President.

J. K. REBEL, President.

24-tf

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

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MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

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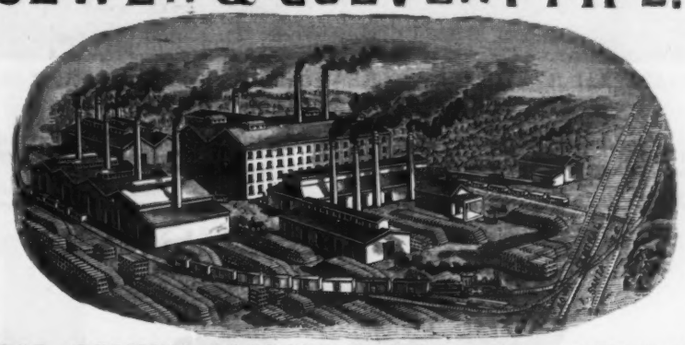

MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

To Contractors.

Sealed proposals will be received at the office of the Colt Land Company, No. 148 Ellison St., in the City of Paterson, N. J., on or before Thursday, July 10, at 3 o'clock P. M., for the removal of Colt's Hill, in the City of Paterson. The hill contains about 275,000 cubic yards of sand.

Specifications can be seen at the office of Hilton & Menger, Engineers, No. 209 Main St., Paterson, N. J. 26-2t

Watkins, N. Y., Water-Works.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the Board of Water and Sewer Commissioners of the village of Watkins, N. Y., until 2 o'clock P. M. July 23, 1890, at their office, for the material and labor required to construct water works in the village of Watkins. Proposals must be made upon blank forms furnished by the Commissioners, and be accompanied with cash, certified check or draft for $100, payable to the Treasurer of the Board of Water and Sewer Commissioners, as a guarantee for the execution of a contract if the proposal shall be accepted. The right is reserved to reject any and all proposals not considered for the interest of the village. Specifications may be had on application, or seen at the office of the Commissioners in this village.

Dated, WATKINS, N. Y., June 23, 1890.

DANIEL BEACH,
OLIVER P. HURD,
FREDERICK DAVIS, JR.,
WILLIAM H. WAIT,
WILLIAM N. LOVE,
Board of Water and Sewer Comrs.

26-1t

To Highway Contractors.

To all whom it may concern: "Whereas the Common Council of the city of Dunkirk, at a regular meeting thereof, held at the Council room in said city on the 17th day of June, 1890 did resolve to macadamize the roadway in that part of Central avenue lying between Third street and Fifth street, to the width of forty (40) feet, together with the necessary curbing, guttering and crosswalks, and whereas said Common Council did at the same time and place direct the City Clerk to advertise in the city paper and in some general contractors' paper for bids for the materials and labor necessary for the carrying on of such improvement." Now, therefore, take notice that any and all persons desiring or willing to furnish the necessary materials for the said improvement and to do the said work are hereby invited to make proposal therefor and seal them and deliver them to the undersigned, at his office in said city; and further take notice that any person desiring to bid on said work and materials by application to the expert civil engineer George D. Baker, Dunkirk, N. Y., will be furnished with Complete Specifications showing the work to be done, the materials to be furnished and the form and manner in which such work must be done and the material used. The bids must be delivered to the undersigned on or before Tuesday, July 8, 1890, at 7:30 o'clock P. M., at which time such bids will be opened and read in public by the Mayor and Common Council assembled. The Common Council reserves the right to reject any and all proposals.

Dated, DUNKIRK, N. Y., June 21, 1890.

EDWARD MADIGAN, City Clerk.

26-1t

Salt Lake City Corporation.

Notice to Contractors.

Sealed proposals will be received addressed as below until 12 M., July 5, 1890, for furnishing material and constructing about six miles of brick conduit of two miles of wrought-iron pipe line with all necessary earthwork and appurtenances. To be endorsed "Proposals for Conduit and Pipe Construction."

Plans can be seen and specifications obtained on and after June 24, 1890, at office of City Engineer, or Room 606, Progress Building, Salt Lake City.

Approximate quantities are as follows:

Earth and rock work.....85,000 cubic yards.
Brick and stone masonry ...11,000 " "
Wrought iron pipe.....12,000 linear feet.

Bids will be received for the whole or portions of the work, and must be made upon forms furnished by the undersigned.

All proposals to be accompanied by satisfactory evidence of the bidder's ability to perform the work.

A certified check for $2,000, made payable to the City Treasurer of Salt Lake City, must also accompany each bid, the same to be forfeited to said city if the successful bidder fails to enter into contract with the city and furnish a bond acceptable to and in such an amount as may be required by the City Council thereof within three (3) days after the awarding of said contract.

The right is reserved to reject any and all bids.

Address Board of Water Commissioners, City Hall, Salt Lake City.

A. F. DOREMUS, M. J. MACK, C. L. STEVENSON, } Commissioners.

Per resolution of City Council, June 17, 1890.

26-1t

PROPOSALS

FROM

TUNNEL CONTRACTORS

THE CATARACT CONSTRUCTION COMPANY

invites proposals until July 19 from contractors for constructing the

TUNNEL OF 8,000 FEET

more or less, with cross section about eighteen by twenty-nine feet of

THE NIAGARA FALLS POWER COMPANY

at Niagara Falls, N. Y.

Contractors will be expected to personally inspect the site before making proposals. For form of contract, proposal, and information, apply, after June 28, 1890, to

ALBERT H. PORTER, Engineer, Niagara Falls, N. Y.

26-3t

To Tunnel Contractors.

PITTSBURGH, CINCINNATI & ST. LOUIS RAILWAY CO., Chief Engineer's Office, PITTSBURGH, Pa., June 23, 1890.

Sealed proposals will be received until July 8 for the widening and arching of a portion of Gould's Tunnel, on the P., C. & St. L. Ry., seven miles west of Steubenville, O., embracing 16,800 cubic yards of tunnel excavation, 2,810 cubic yards stone masonry in foundations and side walls, and 5,705 cubic yards of brick masonry in arches. Specifications and plans for the work can be seen at the above-named office from this date.

M. J. BECKER, Chief Engineer.

26—1t

To Tunnel Contractors.

By September will let about 3,000 yards brick work in tunnel at this place. We will furnish all material, and require first-class bond from the sub-contractor.

McCORMICK & O'MEARA, No. 904 Olive St., St. Louis, Mo.

25-8t

(*For other Proposals See Pages XV. and XXII.*)

50 Cts. **WANTS.** 50 Cts

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THE CHEAPEST ALUMINUM

As well as the best, is offered to the trade by

THE COWLES

Electric Smelting & Aluminum Co.,

OF CLEVELAND, O.,

At $2.00 per pound for the Aluminum contained in an alloy with copper, and $1.60 per pound when alloyed with iron. The same subject to analysis.

Manufacturers of Manganese Bronze, Aluminum and White Silver Bronze.

Heavy Castings a Specialty.

WANTED.—A few good tunnel men. Address R. P. McCORMICK & CO., Room 30, 904 Olive street, St. Louis, Mo., or call at 10 Park Place, New York City. 17-10t

WANTED.—An engineer of 20 years' practical experience on railroads in the North, South and West is open to an engagement. Will accept position as chief of party on preliminary or location, or division engineer on construction. Have complete set of field instruments. Best of references can be furnished. Will be glad to confer with parties desiring the services of an engineer. Address T. G. BAYLOR, Charlestown, Jefferson County, West Virginia. 23 4t

WANTED—Work by a young man who will graduate in civil engineering this month, and whose main object is to gain experience. Bridge work preferred. At liberty about July 1. A, N. O. F., care Engineering News, 24-3t

WANTED.—An instructor in civil engineering in a leading technical school at a salary of $900 per annum. Applicants must be graduates of '87 or earlier and must submit specimens of drawing and lettering on a sheet about 3 x 5 ins. Address Professor C. E., care ENGINEERING NEWS. 25-2t

WANTED.—Position as draughtsman, experienced in making working plans and neat tracings for blue prints on land surveys and railroad work. Address M. C., care of Engineering News. 25-3t

WANTED.—Position as office man and draughtsman combined in Division Engineer's office; good accountant and neat draughtsman. Address D. C., care of Engineering News. 25-3t

WANTED.—A competent lady cashier, of four years' experience, desires a position. Will give the best of reference from present employer. Address LADY CASHIER, Engineering News. 25-3t

WANTED.—Position (in California preferred) as Draftsman by a first-class topographical and general draftsman of twenty years' experience in U. S. Engineers' Department and other important railroad and city offices. Especially proficient in topography and lettering. Can furnish the highest testimonials as to ability and character. Address "A," care of Engineering News. 25-3t

WANTED.—Good locating engineer for mountain work, topographer and draughtsman. Also shortly, a good tunnel engineer. All must be men of first-class experience for their respective positions. Address, stating experience, references and salary expected, W. L. M., Engineering News. 25-3t

WANTED.—Index to Volume XVII., January to July, 1887, of Engineering News, for which we will pay fifty cents. Engineering News. 25-3t

WANTED.—Mechanical engineer, A No. 1 designer, with 15 years' practical experience in building engines, steam pumping and mining machinery, wishes to change. Reliable parties in need of a superintendent, manager, or chief engineer address "ENERGY," care of Engineering News. 25-4t

WANTED.—Position on railroad location or construction, by a young man who has had four years practical experience. Will go anywhere. Address H., Engineering News. 25-3t

WANTED.—Graduate civil engineer, with eleven years' experience on surveys and construction of first-class railroads, desires responsible position, such as locating or division engineer. Have full set of instruments At liberty July 1. Best references furnished. Address GROVER, Engineering News. 25—

WANTED.—A young man, having experience in office and field work, desires position. Can use transit, good mathematician, understands office work. Address "C. P.," Engineering News. 26-1t

WANTED.—Position as instrument man on railway location or charge of construction party. Can furnish full set of instruments. Experience and good reference. Address B., care of Engineering News. 26-1t

WANTED.—A graduate engineer is open to engagement on survey or construction work. Is competent to take charge. Address "Z.," care Engineering News. 26-1t

WANTED.—Young German mechanical engineer, with practical and theoretical knowledge, wants position as draughtsman or any other suitable employment in a steam engine or locomotive factory. Address A. KRUG, care Engineering News. 26-1t

WANTED.—A competent Engineer and Draftsman to make detail shop drawings for iron bridge and roof work. None but best men with experience need apply. Applications by letter only, giving references. Permanent position. MILLIKEN BROS., 55 Liberty St., New York City. 26-1t

Paige, Carey & Co.---D. R. Paige & Co.

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Estimates made on all classes of Engineering work.

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Vitrified and Salt Glazed,

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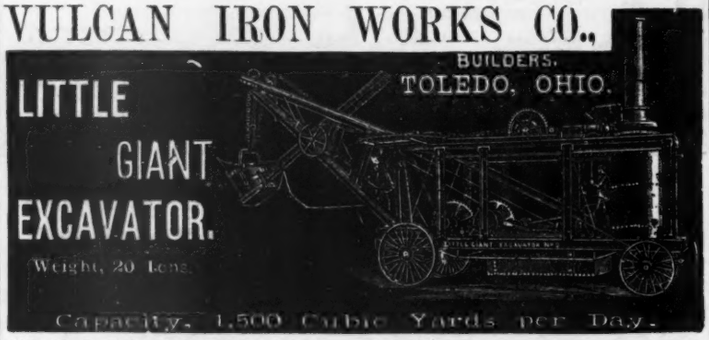
TOLEDO, OHIO.



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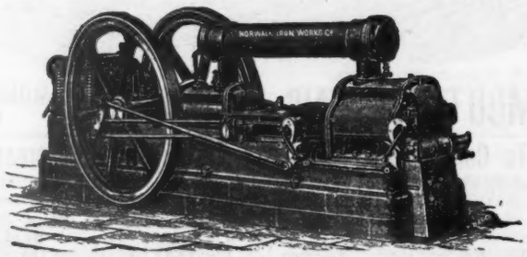

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ESTIMATES FOR ARCHITECTURAL, MONUMENTAL AND STREET PAVING WORK WILL BE PROMPTLY FURNISHED.

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A Manual of Maintenance of Way,

BY WM. B. PARSONS, JR., C E

PRICE, $2.00.

WANTED.—Two competent bridge draughtsmen. Only those conversant with best shop practice and competent to make complete working drawings need apply. State salary wanted and earliest date services available. MT. VERNON BRIDGE CO., Mt. Vernon, O. 26—

WANTED.—To add to office force in large shops in Chicago, one or two Draftsmen experienced in Corliss and general engine designing; also, one or two Draftsmen experienced in mill building constructions and general machinery. Address C. F., care Engineering News. 26—

WANTED.—Real estate engineer, experienced in the laying out and improvement of villa site property, water-works and sewerage, is open to engagement. Address Engineer, Box 397, Huntington, N. Y. 26-3t

WANTED.—Young engineer of at least two years' field experience, or five years if not a graduate, for service in Cuba; must have good working knowledge of transit and level, and be able to make and plot a limited hydrographic or railway survey; knowledge of Spanish a recommendation. To the right man the position is likely to be permanent, with a good chance for promotion. Address, stating age, experience and salary expected, "CUBA," care Engineering News. 26-3t

WANTED.—An engineer with fifteen years' practical experience, wishing to exchange present position for one offering a better field, will correspond with parties desiring services of a Chief Engineer thoroughly experienced in railroad surveys, construction and maintenance. C. ENGINEER, care Engineering News. 26-4t

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This motor has more valuable features. Greater economy in the use of water. Gives a higher efficiency than any other in the world. Large or small sizes.

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For Sale Cheap.

A quantity of 6, 10 and 12-in. cast iron pipe, R D. Wood & Co. make, tested to Government standard and weights; has been used only to convey compressed air and is good as new. Also a quantity of wrought-iron pipe 1, 2, 3 and 4 in. in good order, besides compressor, boiler, engine, derricks, 3 Knowles steam pumps, steam boiler, one steam shovel and a large amount of contractors' plant. For particulars, price, etc., inquire of

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One perfect copy of **Drinker's "Tunneling"** of the edition of **1878.** Price $16 and express charges to purchaser. Address

ENGINEERING NEWS.

The question of how to build up a newspaper's circulation is one that interests all publishers, whether of city or country papers. The advertiser—to whom the publisher must look for a large proportion of his direct income—has no use for the paper which has not solved the problem. Mr. J. F. Mitchell, of the Greenville *Banner*, struck the nail on the head when he said, in addressing the Texas Press Association recently, that to build up and maintain a good circulation you must build up and maintain a good paper. The basis to build on consists of brains, education, industry, courage, honor, and "a nose for news."

THE COMPANY AN ADV. KEEPS.

There is a common-sense saying that "it pays to buy the best." If this rule applies to anything, it applies to advertising space. If you are a local advertiser, patronize your best local medium, by all means, and do it steadily. If you are looking for a broader market, do not be induced to use papers and magazines because they are cheap. The largest circulations are the cheapest in the long run, and your announcements gain a certain dignity and standing by appearing in a periodical whose space cannot be bought for love or money by disreputable advertisers.—*Art in Advertising.*

The Gaskill-Holly Pumping Engine.

ITS RECORD UNPARALLELED!

Comparison Challenged with any Other in the World!

96 OF THESE JUSTLY CELEBRATED ENGINES CONTRACTED FOR IN THE LAST TWO YEARS, AVERAGE DAILY CAPACITY OF WHICH IS 3,915,625.

CONSIDER THE POINTS WHICH DEMONSTRATE IT:

1. The first Gaskill crank and fly-wheel pumping engine was built and put in ervice at Saratoga Springs, N. Y., in 1882, eight years ago.

2. Since that time 118 of these engines have been constructed or contracted for, an average of about 15 per year.

3. DURING LAST YEAR—1890—40 HAVE BEEN BUILT OR CONTRACTED FOR, AVERAGING ONE EVERY NINE DAYS. Average daily capacity, 3,915,000 gallons.

4. The duty of the first engine of this type at Saratoga, on contract test, was 12,899,983 foot-pounds per 100 pounds of coal consumed.

5. The average duty of above engine in current service from 1884 to 1889, inclu-ve—six years—was 105,910,739 foot pounds from coal actually consumed.

6. During the above interval of six years the cost of repairs was less than $100, as certified by officials in charge.

7. Another engine of the same type, of 8,000,000 gallons daily capacity, was constructed for Saratoga Springs, and tested and accepted in October, 1889. The duty obtained, as reported by Prof. Greene, of Troy, N. Y., was 113,378,479 foot-pounds from coal consumed, and 117,936,698 on an evaporation of ten to one.

8. Other engines of the same type, in number about forty, have been tested by some of the most eminent engineers in the United States, all of them developing high duty, beyond all former precedent; and at Dayton, O., eclipsing 10,000,000 Engines in a duty of 124,782,157 foot pounds on a ratio of ten to one evaporation.

9. The capacity of these engines manufactured thus far ranges from 1,000,000 to 20,000,000 gallons daily.

10. They are in use in Boston, Philadelphia, Chicago, Buffalo Washington, Kansas City, Omaha and other large cities in the United States.

11. The aggregate capacity of these engines, constructed or contracted for to date, is 555,000,000 gallons daily, which, with other types, make a grand total of 356 engines and 1,077,150,000 gallons, with an average of 3,025,700 each.

12. In symmetry of proportion, weight, strength, economy, durability, price, comparison is challenged with any other engine manufactured if this or any other country.

13. An illustrated pamphlet of about 300 pages is going through the press, giving full history of the above phenomenal pumping engine, with full reports of duty tests in detail as made by about thirty mechanical experts, eminent in their profession, which will soon be ready for delivery and which will be mailed upon application to all who are interested in, or may have occasion to purchase, pumping engines. The book demonstrates beyond all dispute that the Gaskill compound crank and fly-wheel pumping engines, manufactured, under patents, by the Holly Mfg. Co., far surpass any other engine manufactured in the world.

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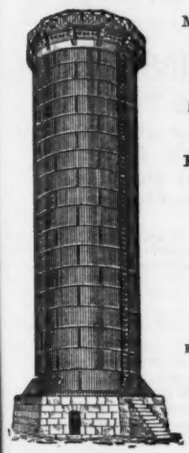
HOLLY MANUFACTURING COMPANY, LOCKPORT, N. Y.

Porter Mfg. Co., Limited.



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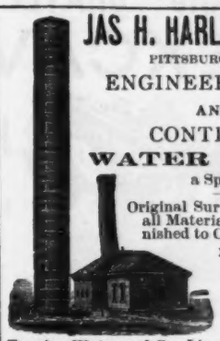
Original Surveys Made, and all Material and Labor, furnished to Completion.



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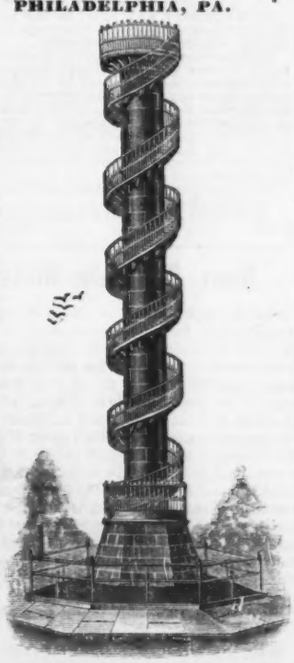

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Of any Power and Style, SINGLE AND DOUBLE CYLINDER, with improved patent friction drums especially adapted for bridge building, dock building, pile driving, coal hoisting, quarries, mines, etc. Any amount of references given.

J. S. MUNDY, Newark, N. J.

Send for catalogue.

This patent has been sustained in the U. S. Circuit Court for the Southern District of N.Y., by Judge Wheeler, also in the U. S. Circuit Court for District of N. J., by Judge Nixon.

Low Rates to Dealers, Officials, Contractors

PIPE OF ALL SIZES ON HAND.

Wire or write for Samples, etc.

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STEEL BELT LACING.

SAVES TIME, MONEY AND BELTING.

Quickly Applied. Requires no Special Tools. Box of 67 inches Assorted. Prepaid for $1.00.

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COMPLETE STEAM PUMP

10 SIZES FROM $7 TO $75

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Hydraulic, Jetting, Revolving, Artesian, Diamond Prospecting Tools, Engines, Boilers, Wind Mills, Pumps. **Encyclopedia** 1,000 engravings, Earth's Strata, Determination quality water; mailed, free.

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Boiling & Lowe, Lawrence Pountney Hill LONDON, ENG

Edict of the Department of Public Works in the State of Para, Brazil.

SEWERAGE OF PARA, BRAZIL.

According to what the law No. 135, of April 11, of the present year, determines, and by order of the Citizen Director of this department, I make known to be in competition for four months' time, counting from the date of the said law, the establishment of a complete line of sewerage for the capital of this State, according to the text:

Instructions for the concession of a privilege for the establishment of a complete line of sewerage, according to the technical principles and the following articles:

COMPETITORS AND PROPOSALS.

1st. The competitors must have a complete knowledge of all the local circumstances, and have the necessary resources to begin and to finish the works and must give security that they will faithfully complete the works.

The proposals and all the papers that may come with them must be sealed, and their signatures witnessed.

The competitors will sign their proposals with their full names and give their residences.

The proposals must be accompanied by:

I. A proof of the deposit of the amount of 10 contos de reis in money (about $5,000), or government bonds; the proposals will not be taken into consideration without this proof.

II. Documents proving that the competitors have the necessary professional knowledge.

III. Tablets of the taxes that must pay every 6 months at the time of the collections of the taxes on buildings, and upon the same circumstances, all the existant buildings and those that may be built within the limits of the city and suburbs served by the line of sewerage, according to its local value, to help to pay the expenses of the works, remuneration and amortization of the capital employed in the works. These taxes will be collected by the competent department of the State, together with the taxes on buildings on the same ways, and delivered after every 6 months to the company that may be organized.

IV. The reductions on said taxes in the case of being given to the company the right to import from abroad free of taxes all the materials and tools for the works.

V. The space of time for presentation of the studies and definitive plans of the works, and of all details of same that may be required by the director of the Municipal Department, by the engineer, and also the time to begin and to finish the works.

TECHNICAL CONDITIONS, CONSTRUCTION AND REPAIRS.

2d. The project and the descriptive memorial of the works to be done, that accompany the proposals will clearly specify:

I. The limits of the city and suburbs in which the service is to be made.

II. The principal and secondary canalizations and its ramifications in the public roads, with indications of the respective diameters, thickners and declivity; also the kind of materials, having in view a population twice the present one.

III. The canalizations to be constructed in the low and high buildings, public or private ones, that are already built or that may be built, until the works are finished in the limits of the city, with identical indications to those of No. II.; description of the apparatus to intercept the gases, of the general collectors to the buildings, chimneys of ventilation, their collocation, material, etc., and their height above the highest top of the building or of the neighboring ones.

IV. The kind of inodorous water closets, water tanks for them, basins, grates, tanks for the washing of the conduits, and intercepting syphons, separating apparatus of the kitchen's waters, ventilating chimneys, and the other apparatus necessary for the regular and hygienic work of the proposed system.

V. The stations for the works, their dimensions and system of construction, localities where they will have to be built, their number, dimensions and kind of tanks for collecting, disinfecting and straining the products from the sewerage, kind and force of the engines, ways of disinfection, and heights of the openings of the galleries.

VI. System of public water closets and urinals, the ways of working, cleaning and sanifying them.

VII. System of washing the general and secondary canalizations, and the respective furnishing of water.

VIII. System of ventilation of the public and private canalizations.

IX. System of joining the sewerage of each building to the canalization of the streets.

X. System of the consolidation of the ground for the protection of the conduits, and to avoid the abasement of the soil.

XI. System of canalization when necessary to cross a marsh, combined with No. X.

XII. Indications of the precautions to be taken when the canalization has to go under walls, buildings, etc.

GENERAL CONDITION.

3d. The contractor will extend the line of sewerage whenever the government require it to new suburbs, or streets outside of the limits to which he has agreed, and to do so immediately as soon as the corresponding incomes in view of the expense calculation organized by the company and approved by the Government be equivalent to 7% per year on the expenses.

4th. The services of the sewerages in the public and religious establishments that are supported or auxiliated by the Government shall be done free of charge.

5th. In the number of the works required by the proposed system, and that the contractor or company will have to do at his own expenses, are also included the next ones:

I. All the canalizations inside of the buildings for the sewerage of water closets, dirty and rain water, of marshy and sandy places, and also the furnishing of a water closet (of the kind adopted by the government) in each floor of the buildings, with the respective water tank, and a grate with syphon to each yard, a chimney of ventilation, and the apparatus for the interception of the gases of the general canalizations to those of the residences; all the owners of buildings wishing other canalizations and apparatus will have to pay for the value of the material and work done, by tablets that will be approved by the government.

II. The complete furnishing and placing of the public water closets and urinals.

III. The construction of water tanks, for the washing of the canalisations and galleries, according to the kind and dimensions agreed.

IV. The furnishing and placement of the water closets and syphon on the places called "estalgen" (a place where are builded several small houses to rent to poor families) for each group or fraction of five houses.

6th. The government of the state will give as much as 50 years privilege to the company that may be organized, and guarantees to pay the interest of 6% per year calculated on the capital fixed; it will be agreed on the final contract, upon the amortization of the total incomes, and the way the interest is to be paid, etc.

7th. At the end of the privilege time, all the construction will belong to the Municipal Department of the capital of the State without any indemnity; the contractor having the preference to the renting of the service should it not suit the Municipal Department to do so itself, provided he pay back all the amounts that the government may have spent on the works and guarantee of interest.

8th. To the contractor the government of the State will give the rights of disappropiation, according to the laws, for the grounds, buildings, properties, etc., etc., that may be necessary for the contracted works.

9th. The government of the State will obtain in favor of the company exemption of customs duties, but without assuming any responsibility, for the importation of materials, tools, machines, coal, chemical products and apparatus necessary for the works.

10th. The contractor or company will place into the hands of the Treasurer of the State on the beginning of each quarter the amount of money that will be agreed with the government for the paying of the fiscalization of the contract.

11th. The contractor who may get the preference will have to sign the contract within 30 days from the date that his preference is published in the newspaper in charge of the government publications, under the penalty of losing his rights.

Palace of the Government of the Confederate State of Pará, April 11, 1890, Second of the Republic.

JUSTO LEITE CHERMONT.

On September 6, at 11 A. M., in the parlor of the government palace of this state, the commission will examine the proposals.

All persons residing in France, England, Portugal, United States of North America, and other places where this may be published, as well as those residing in the different States of the Brazilian Republic, may present themselves as competitors and be present or be represented by some one legally authorized to do so, on the day and hour appointed to show the proposals, basing them on the clauses of the present instructions.

Municipal Department Building of the State of Pars, May 6, 1890.

OLYMPIO ANTONIO VAZ DE LIMA,
Secretary.

25-10t

Sioux City Water-Works.

Sealed proposals will be received by L. H. Drumm until Tuesday, July 8, at 5 o'clock P. M., for furnishing, laying and completing water mains. The following are the approximate quantities: 13,345 ft. of 8-in. cast iron pipe, 42 lbs. per ft.; 10,540 ft. of 6-in., 33 lbs. per ft.; 3,086 ft. 4-in., 22 lbs. per ft.; about 22,226 lbs. special casting, 29 double valves, Mathews fire hydrants, 10 8-in. Ludlow valves, 8 6-in. and 5 4-in. All bids must be accompanied by a bond in penal sum not less than 40 per cent. of the amount bid, conditioned that if the bid be accepted the party making will enter into a contract with the city of Sioux City and faithfully perform all the conditions of contract. The right is reserved to reject any or all bids.

(Signed) L. H. DRUMM,
Chairman Water Committee,
No. 1411 Geneva St.,
Sioux City, Ia.

25-2t

Proposals for Waterworks.

Sealed proposals addressed to the City Clerk will be received by the city of Galesburg, Ill., until 5 o'clock P. M., July 8, 1890, for furnishing materials and labor, and doing the work required to build a system of waterworks in and for said city. Proposals will be received for the whole or the separate portions of the work, and the plans and specifications may be seen at the office of the City Clerk, or at the office of the Engineer in Chicago, after June 24.

Accompanying each proposal must be a certified check payable to the city of Galesburg, Ill., or its equivalent, for $500, as a guarantee that the bidder will enter into and execute the contract awarded him, and which deposit will be forfeited if he fails so to do.

The right is reserved to reject any or all bids.

By order of the City Council.

JOHN C. STEVENS,
City Clerk.

CHESTER B. DAVIS, Engineer, 549 Rookery Building, Chicago, Ill. 25-2t

ROBERT POOLE & SON CO.,

MANUFACTURERS OF

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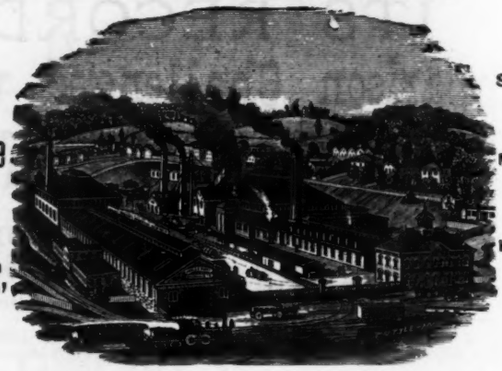
THE POOLE & SON, LEFFEL TURBINE WATER-WHEEL.

Superior Machine Molded Gearing,



Spur, Bevel, Angle, Mortise, Helical, Double Helical and Worm;

Steam Engines and Boilers,—Driving Plant for Cable Railways.

Machinery for Flour Mills, Grain Elevators, White Lead Works, Fertilizer Factories and Dredging Machines.

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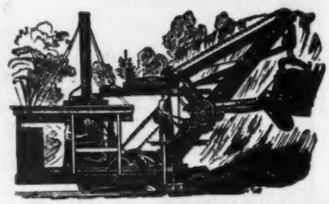
OTIS & CHAPMAN,

STANDARD GRAVEL AND HARD PAN EXCAVATOR,



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BOSTON.

Earth displaced at ONE-QUARTER LESS EXPENSE than by any other machine.

To Whom it May Concern:

I hereby certify that I have used the Otis patent improved Steam Excavators the past twenty years, in all kinds of earth excavation, and believe it to be the best dry land excavator in use, and the only one that will work successfully in hard pan material. I have excavated and put into cars five million yards under one contract for making land in Boston; with two of these machines I loaded from seventy to eighty thousand yards per month.

N. C. MUNSON.

Hicksville Water-Works.

Notice to Contractors.

Sealed proposals will be received by the Trustees of Water Works of Hicksville, Defiance County, Ohio, at their office in said city, until 12 o'clock noon of Wednesday, the 16th day of July, 1890, for furnishing materials and constructing Water Works in and for said city, approximately as follows:

The furnishing of 1,170 lineal feet (35.9 tons) of 10-inch pipe, 960 lineal feet of 8-inch pipe (24 tons), 7,050 lineal feet (116.5 tons) of 6-inch pipe, 13,980 lineal feet (160.8 tons) of 4-inch pipe; also, the furnishing of, approximately, 5 tons of special castings; also, 1 10-inch valve, 1 8-inch valve, 11 6-inch and 17 4-inch valves; also, 30 valve-boxes and covers; also, 35 fire hydrants; also, the furnishing of all other materials, tools and labor, and laying said pipe and setting said valves and hydrants; also, the sinking, tubing and completing of four or more supply wells; also, the furnishing and erecting of two pumping engines, each with a capacity to pump 1,000,000 gallons of water per 24 hours. Bids will also be received for two pumping engines of lesser capacity, the Trustees reserving the right to accept either, all as set forth in specifications; also two return tubular steel boilers and fixtures, each approximately 54 inches diameter and 12 feet long; also, one building, to be sub-divided into an engine room approximately 20 by 20 and a boiler room 20 by 32 feet in plan.

Bids will be received in any aggregate or detail, at the option of bidders.

Detailed drawings will be ready for the examination of bidders on or before July 10, from and after which date, also, specifications, forms of proposal and forms of contract will be furnished.

The right is reserved to increase or diminish any of the above quantities or dimensions as the Trustees may elect after receiving proposals for same, and the right to reject any or all bids is also hereby reserved.

T. C. KINMONT, Pres.,
W. D. WILSON.
F. N. HORTON.
} Trustees.

J. D. COOK, Toledo, O., Consulting Engineer.

HICKSVILLE, Ohio, June 16, 1890. 25-3t

To Water-Works Contractors.

OFFICE OF THE PRESIDENT OF THE BOARD OF PUBLIC IMPROVEMENTS,
ST. LOUIS, June 23, 1890.

Sealed proposals for the public work hereinafter mentioned will be received at the office of the Board of Public Improvements, until 12 m. of the 8th day of July, 1890, at which hour they will be publicly opened and read, viz:

Letting No. 3,111. For making the required excavation and embankment and building Section A of the LOW SERVICE CONDUIT (excepting the Terminal Chamber) complete in working order.

The following are the approximate quantities of the work to be done, viz:

(*a*) 57,500 cu. yds. embankment.
(*b*) 500 cu. yds. cinders.
(*c*) 3,300 cu. yds. soil dressing.
(*d*) 2,300 cu. yds. rip-rap.
(*e*) 330 cu. yds. rough rock.
(*f*) 330 cu. yds. macadam.
(*g*) 7,600 cu. yds. concrete.
(*h*) 3,600 cu. yds. brick masonry.
(*i*) 37,700 sq. ft. granitoid.
(*j*) 413 lin. ft. 48-in. pipe.
(*k*) 11 cu. yds. stone masonry, Class X.
(*l*) 30 cu. yds. stone masonry, Class N.
(*m*) 1 granite sill for outfall.
(*n*) 18 piles furnished and driven.
(*o*) 10,000 ft. B. M. lumber in place.

Deposit required, $2,950.

Proposals must be made on blank forms furnished by the Board of Public Improvements.

The right to reject any and all proposals is expressly reserved.

Plans may be seen and specifications and forms of contract may be obtained upon application at the office of the Water Commissioner, Room 27, City Hall.

By order of the Board.

GEO. BURNET,
President.

Attest:
EMORY S. FOSTER,
Secretary.

Alphabetical List of Advertisers in Current Number of ENGINEERING NEWS, June 28, 1890:

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Blackmer & Post, St. Louis, Mo	1
Bloomsburg Car Co., Bloomsburg, Pa.	5
Blake Mfg. Co., Geo. F., Boston & N. Y.	31
Boggs, Edw. M., San Bernardino, Cal.	2
Booth Bros. & Hurricane Isle Granite Co	11
Boston Bridge Works, Boston, Mass.	26
Boston & Lockport Block Co., Boston.	10
Bourbon Copper & Brass Works, Cincinnati, O.	16
Bouscaren, G., 99 W. 4th St., Cincinnati, O.	2
Bowers, A. B., Washington, D. C.	32
Bower-Barff Rustless Iron Process, N. Y.	19
Boynton, C. W., Sewaren, N. J.	30
Brand, James, 81 Fulton St., N. Y.	11
Brightly, Chas. H., Phila.	14
Bristol's Mfg. Co., Waterbury, Conn	21
Brown Hoisting & Conveying Machine Co., Cleveland, O.	25
Brown & Co., Jas. M., N. Y.	7
Buckeye Portland Cement Co., Bellefontaine, O.	11
Bucyrus Steam Shovel & Dredge Co. Bucyrus, Ohio	24
Buff & Berger, 9 Province C't, Boston, Mass	14
Buffalo Cast Iron Pipe Co., Buffalo, N. Y.	35
Buffalo Steam Pump Co., Buffalo, N. Y.	33
Builder's Iron Foundry, Providence, R. I.	18
Butterworth, Hall, Brown & Smith.	2
Byram & Co., Detroit, Mich.	31
Cameron, A. S., Steam Pump Works, N. Y.	18
Carlin's Sons, Thos., Allegheny, Pa.	32
Carlisle Mfg. Co., Carlisle, Pa.	4
Carolina Oil & Creos. Co., Wilm'gt'n, N. C.	6
Carson Trench Machine Co., 21 Hamilton St., Boston.	36
Cartter & Co., M. S., St. Louis, Mo.	28
Cassin, Isaac S., 1404 N. 12th St., Phila., Pa.	2
Chance, H. M., Philadelphia, Pa.	7
Chapman Valve Mfg. Co., Indian Orchard, Mass.	17
Champion Bridge Co., Wilmington, O.	28
Chase Combination Car Spring Co., N. Y.	5
Chattanooga Foundry & Pipe Works, Chattanooga	35
Chicago Tie Preserving Co., Chicago	6
Chicago Bridge & Iron Co., Chicago	27
Claffy, John, 48 Dey St., N. Y	7
Clarke, Thomas C., 1 B'way, N. Y.	2
Clayton Air Compressor Works, 43 Dey St., N. Y.	1
Cleveland Pipe Works Co., Cleveland, O.	35
Clinton Wire Cloth Co., Clinton, Mass.	20
Cockburn Barrow & Machine Co., Jersey City, N. J.	30
Cofrode & Saylor, Philadelphia, Pa.	29
Cofrode & Evans, Pottstown, Pa.	26
Colliau, Victor, Detroit, Mich.	34
Columbia Bridge Co., Dayton, O.	26
Columbus Bridge Co., Columbus, O.	28
Congdon Brake Shoe Co., Chicago, Ill.	8
Contractors' Plant Mfg. Co., Buffalo, N.Y.	16
Cook Well Co., St. Louis, Mo.	10
Cooley, L. E., 171 La Salle St., Chicago, Ill.	7
Cooper, Hewitt & Co., New York	29
Cooper, Theodore, New York	28
Cowles Electric Smelting & Aluminum Co., Cleveland, O.	20
Cram, R. J. & A. B., 80 Griswold St., Detroit, Mich	30
Cumberland Mfg. Co., 220 Devonshire St., Boston, Mass.	19
Cumberland Hydraulic Cement M.Co., N. Y	11
Cuozzo, D. Stapleton, S. I.	7
Curtis, Walter W., St. Paul, Minn.	2
Davidson St'm Pump Co.,77 Liberty St., N Y	33
Davis, Chester B., Chicago, Ill.	7
Dean Bros.' St'm Pump Wks, Indianapolis.	31
Deane Steam Pump Co., Holyoke, Mass.	31
Deinelt & Eisenhardt, Philadelphia, Pa.	30
Delafield, C., 2 Wall St., New York	1
Detroit Pipe & Foundry Co., Detroit, Mich.	35
Diamond Fire Clay Co., Uhrichsville, O.	30
Dickey, W. S. Mfg. Co., Kansas City, Mo.	20
Dickinson Bros. & King, 24 State St., N. Y.	11
Dickinson, P. P., 7 Nassau St., New York.	2
Dodwell & Hogg, Montreal, Que.	2
Donaldson Iron Co., Emaus, Lehigh Co., Pa	35
Drummond, M. J., Corbin Bldg., 192 B'way, N. Y.	35
Dunham Mfg. Co., Boston, Mass.	18
Dye & Datesman, 706 Chestnut St., Phil. ,Pa	2
Eddy & Co., George M., Brooklyn, N. Y.	14
Eddy Valve Co., Waterford, N. Y.	16
Edge Moor Bridge Wks. Wilmington, Del.	27
Edwards & Co., Joseph, 412 Water st., N. Y.	33
Eglee, Charles H., Flushing, N. Y.	2
Elmira Bridge Co., Elmira, N. Y	27
Endicott & Macomber, Boston	1
English, Morse & Co., Kansas City, Mo.	24
Eppinger & Russell, 160 Water st., N. Y.	6
Evans, Geo. A. 40 Wall St., N. Y, Front Cover	
Excelsior Sewer Pipe Works, Calumet, O.	30
Fairleigh & Betts, Chattanooga, Tenn.	7
Fanning, J. T., St. Paul, Minn.	7
Farrell Foundry & Mac. Co., Ansonia, Conn.	34
Fauth & Co., Washington, D. C.	14
Ferris, G. W. G., & Co., Pittsburgh, Pa.	2
Filley & Co,, Kansas City, Mo	2
Filley, H. H., Kansas City, Mo.	2
Fisher, Erskine W., 18 B'way, N. Y	11
Fisher Rail Joint Works, Trenton, N. J.	8
Fitzgerald, J. L., Schenectady, N. Y.	7
Fleming, Howard, 23 Liberty St. N. Y.	11
Flower & Bros., James, Detroit, Mich.	17
Forsaith & Co., S. C., Manchester, N. H.	31
Foundry and Machine Dept. (Harrisburg Car Mfg. Co.) Harrisburg, Pa.	6
French & Co., Samuel H., Phila., Pa.	7
Frost & Adams, Boston, Mass.	20
Fuller. E. F., 11 Wall St., N. Y.	7
Fuller, Frank L., 12 Pearl St., Boston, Mass.	2
Galvin Brass & Iron Works, Detroit, Mich.	17
Gardam, William & Son, 96 John St., N. Y.	14
Gilbert, B. L., 50 B'way, N. Y.	1
Glamorgan Co., Lynchburg, Va.	35
Gloucester Iron Works, 401 Chestnut St. Philadelphia, Pa.	34
Goodell, Jno. M., 108 E. 23d St., N. Y.	7
Gordon Steam Pump Co., Hamilton, O.	32
Greene, B. D., 50 Broadway, N. Y.	2
Griffin Wheel & Fdry Co., Chicago	4
Groton Bridge & Mfg. Co., Groton, N. Y.	28
Guild & Garrison, B'klyn, N. Y.	33
Gurley, W. & L. E., Troy, N. Y.	14
Hall Signal Co., 50 Broadway, N. Y.	4
Harlow & Co., Jas. H., Pittsburg, Pa.	21
Harman, Jacob A., Watseka, Ill.	2
Hancock Inspirator Co., Boston, Mass.	32
Hartford, R. Frank, Memphis, Tenn.	7
Hastings Pavement Co., 140 Pearl St., N. Y.	11
Hathaway & Co., I. H., Phila, Pa	28
Heer & Seelig, 19 Madison St., Chicago, Ill.	14
Heisler Electric Light Co., St. Louis, Mo.	32
Heller & Brightly, Phila., Pa.	14
Hersey Meter Co., So. Boston, Mass.	12
Hercules Power Co., Cleveland, O.	34
Hering, Rudolph, 277 Pearl St., N. Y.	2
Hildenbrand, W., New York	4
Hildreth, R. W., & Co., 10 Cedar St., N. Y..	2
Hill, John W., Cincinnati, O.	7, 32
Hill & McGovern, Phila., Pa	19
Hobby, Arthur S., 227 Main St., Cincinnati, O.	2
Hodge & Co., E., Boston, Mass.	16
Holly Mfg. Co., Lockport, N. Y.	21
Holyoke Hydrant & Iron Works, Holyoke, Mass.	17
Hoosac Tunnel Route Fitchburg R. R.	30
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Houghton, A. N., 131 Tremont St., Boston.	2
Houghton, J. H., Boston, Mass.	24
Hudson River Cement Co., 95 Liberty St., N. Y.	11
Hughes Steam Pump Co., Cleveland, O.	33
Hunt & Clapp, Pittsburg, Pa.	2
Hyatt Pure Water Co., 18 Cortlandt St., N.Y.	33
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Iredell, F. W., 10 Park Pl., N. Y	3
J. L. Mott Iron Works, New York City.	11
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Knowles Steam Pump Works, Boston	—
Laidlaw & Dunn Co., Cinn., O	33
Lake Shore Foundry, Cleveland, O.	35
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Lane, P. E., Chicago	28
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Lehigh Valley Creosoting Wks., Perth Amboy, N. J.	6
Lehmann, Karl L., 113 Adams St., Room 17, Chicago, Ill.	2
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Massillon Bridge Co., Massillon, O.	26
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Melcher, Chas. W. St. Louis, Mo.	32
Mellert F'dy & Machine Co., Reading, Pa.	35
Merchant & Co., Philadelphia, Pa	32
Michigan Pipe Co., Bay City, Mich	34
Middleton, W. S., 52 John St., N.Y.	30
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Missouri Valley Bridge & Iron Works, Leavenworth, Kan.	26
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Morse & Son, A. J., Boston, Mass.	20
Mott, J. L. Iron Works, 84 to 90 Beekman St., N. Y.	32
Mullins, Robt. F., 10 Wall St., N. Y.	2
Mundy, J. S., Newark, N. J.	21
Murray, Alfred J., 16 Beaver St., N. Y.	29
Nat'l F'dry & Pipe Wks., Scottsdale, Pa	35
National Meter Co., 252 Broadway, N. Y.	13
National Tube Works, Boston	34
National Water Purifying Co., New York	36
National Water Supply Co., Cincinnati	10
Neuchatel Asphalt Co., Ltd., 265 B'way, N.Y.	11
New England Paving Co., Boston	10
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N. Y. Car Wheel Works Co., Buffalo, N. Y.	36
N. Y. Cement Co., 18 Courtlandt St., N. Y.	11
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Norton, F. O., 92 B'way, N. Y.	36
Norwalk Iron Wks. Co., So. Norwalk, Conn.	20
Norwood Car Replacer Co., Baltimore, Md.	8
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Ohio Pipe Co., Columbus, O.	35
Ohio Valley Fire Clay Co., Toronto, O.	30
Oil Well Supply Co., N. Y.	31
Old Dominion Creosoting Works, Norfolk, Va.	6
Osborne & Son, R. B., Philadelphia, Pa.	7
Osgood Dredge Co., Albany, N. Y.	24
Ostrom, John N., 198 Broadway, N. Y.	2
Otis & Chapman, Boston, Mass.	22
Otto Gas Engine Works, 151 Monroe St., Chicago	34
Paige, Carey & Co., and D. R. Paige & Co. N. Y.	20
Paine & Sons, Charles, 71 Broadway, N. Y.	2
Paine, W. H., 102 B'way, N. Y.	2
Pancoast & Rogers, 28 Platt St., N. Y.	35
Parker, M. S., Great Falls, Mont	2
Parsons, Wm. Barclay, 35 B'way, N. Y.	2
Passaic Rolling Mill Co., Paterson, N. J	28
Pennsylvania Steel Co., Steelton, Pa.	1, 8
Peet Valve Co., 163 Albany St., Boston, Mass	17
Pfister, Herm. Cincinnati, O.	14
Phœnix Bridge Co., Phila., Pa.	26
Phosphor Bronze Smelting Co., Phila., Pa.	27
Pierce & Thomas, New York	34
Pittsburgh Reduction Co., Pittsburgh, Pa.	18
Pittsburgh Sewer Pipe Co. New Brighton, Pa.	30
Pond Engineering Co., S. Louis, Mo.	31
Poole, Robt. & Son Co., Baltimore, Md.	22
Portland Cement P. & S. Co., Portland, Me.	1
Porter Beiler Mfg. Co., Chicago, Ill.	22
Porter, H. K. & Co., Pittsburgh, Pa.	4
Porter Mfg. Co., Syracuse, N. Y.	12
Pott, Jno. N., Wilkes Barre, Pa.	2
Pottsville Iron & Steel Co., Pottsville, Pa.	28
Prosser & Son, Thomas, 15 Gold St., N. Y.	4
Pulsometer Steam Pump Co., N. Y. City	19
Queen & Co., Phila., Pa.	14
Ramapo Iron Works, Hilburn, N. Y.	8
Ramapo Wheel & F'dry Co., Ramapo, N. Y.	8
Rand Drill Co., N. Y. City	6
Randolph, T. F., Cincinnati, O.	13
Reliance Gauge Co., Cleveland, O.	14
Rendrock Powder Co., 23 Park Pl. N. Y.	7
Rensselaer Mfg. Co., Troy, N. Y.	13
Riter & Conley, Pittsburgh, Pa.	21
Ricketts, Palmer C., Troy, N. Y.	2
Rochester Bridge & Iron Wks, Rochester N. Y.	26
Rogers, E. L., Denver, Col.	2
Rosewater & Chrysler, Omaha, Neb.	2
Ross & Sanford, Fuller Bldg., J. City, N. J.	32
Ryan-McDonald Mfg. Co., Waterloo, N. Y.	5
Safety Car Heating & Lighting Co., 160 B'way, N. Y.	4
Saunders, Wm. L., 10 Park Place, N. Y.	7
Sanne, Oscar, Milwaukee, Wis.	2
San Francisco Bridge Co., San Fran., Cal.	26
Saxton, E., Kansas City, Mo.	7
Saxton, J. C., 52 B'way, N. Y.	7
Schrader & Son, A., 32 Rose St., N. Y.	20
Schmidt, M. E., Chicago, Ill.	2
Sellers & Co., Wm., Phila., Pa.	4
Searles, Wm. H., Cleveland, O	2
Shailer & Schniglau, Chicago, Ill.	26
Shaw, Edw. S., 146 Franklin St., Boston, Mass.	2
Shedd Water Meter Co., Providence, R. I.	12
Shickle, Harrison & Howard Mfg. Co., St. Louis, Mo.	36
Shunk & Bryson, 12 B'way, N. Y.	2
Sicilian Asphalt Paving Co., New York	11
Sikes, F. G. & G. R., Buffalo, N. Y.	2
Simmerly Derrick Co., Cleveland, O.	24
Smith, A. P., Newark, N. J.	15
Smith Bridge Co., Toledo, O.	28
Smith, Frederick H., Balto, Md	2
Sooysmith & Co., 2 Nassau St., N. Y.	26
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Southern Ry. Construction Co., Chattanooga, Tenn.	7
Southwark F'dy & Machine Co., Phila, Pa.	33
Spiral Weld Tube Co., 43 John St., N. Y..	34
Spon E. & F. N., 12 Cortlandt St., N. Y.	18
Sparks & Evans, Phila., Pa.	27
Springfield Foundry Co., Springfield, Mass	3
Staats, R. P. & J. H., New York	28
Standard Steel Works, Philadelphia, Pa	—
Standard Thermometer Co., Peabody, Mass	6
Stebbins E., Mfg. Co., Springfield, Mass	16
Steel Rail Supply Co., 10 Wall St., N. Y.	21
Stillwell Manufacturing Co., Phila., Pa.	16
Stow Flexible Shaft Co., Phila., Pa	21
Stephens & Mitchell, 722 Pine St., St. Louis, Mo.	2
Stout, Edmund C., 42 B'way, N. Y.	2
Steubner & Woods, Long Island City, N.Y.	11
Sumner & Goodwin, 15 Oliver St., Boston, Mass.	17
Tamaqua Mfg. Co., Tamaqua, Pa.	17
Thacher, Edwin, Louisville, Ky.	28
Thacher & Breymann, Toledo, O.	31
Thiele, E., 78 William St., N. Y.	11
Thomson-Houston Elec. Co., Boston, Mass.	25
Tierney, Miles, N. Y.	7
Tippett & Wood, Phillipsburg, N. J.	21
Toledo F'ry & Machine Co., Toledo, O.	24
Tomkins, Calvin, 387 South St., N. Y. City.	11
Trautwine's Pocket Book	18
Trenton Iron Co., Trenton, N. J.	29
Tripp Mf'g Co., Boston	7
Union Akron Cement Co., Buffalo, O.	11
Union Bridge Co., 1 B'way, N. Y.	27
Union Dredging Co., 34 Pine St., N. Y.	29
Union Hydraulic Works, Phila, Pa.	35
Union Switch & Signal Co., Swissvale, Pa.	1
Union Water Meter Co., Worcester, Mass.	12
Urie Dredge Mfg. Co., Kansas City, Mo.	30
Vaile & Young, Baltimore, Md.	27
Valley Pump Co., Easthampton, Mass.	32
Vanderbilt & Hopkins, 120 Liberty St., N. Y.	6
Van Dorston Cushioned Car Coupling Equipment Co., 308 Chestnut St., Phila.	5
Van Duzen & Tift, Cincinnati, O.	24
Van Wie, Irwin, 48 to 52 S. West St., Syracuse, N. Y.	31
Variety Iron Wks. Co., Cleveland, O.	26
Vermeule, C. E., 71 B'way, N. Y.	2
Vermont Construction Co., St Albans, Vt.	28
Vulcan Iron Wks., Chicago, Ill.	29
Vulcan Iron Wks., Toledo, O.	20
Waddell, J. A. L., Kansas City, Mo.	2
Waring, Jr., Geo. E., Newport, R. I.	2
Waring, Chapman & Farquahar, Newport, R. I.	2
Warner, Henry A., New Haven, Conn.	21
Warren F'dry & Machine Co., 160 B'way, N. Y.	35
Warren Scharf Asphalt Paving Co., 81 Fulton St., N. Y.	36
Washburn & Moen Mfg Co., N. Y.	18
Water Waste Prevention Co., New York.	12
Wehn Pavement Co., N. Y	1
Weir Frog Co., Cincinnati, O.	8
Western Cement Assoc'n, Louisville, Ky.	11
Western Fence Co., Chicago	18
Westinghouse Air Brake Co., Pittsburgh, Pa.	9
White, Wm. Henry, 32 Pine St., New York	2
Williams, Edgar, Chicago, Ill.	2
Wilson Brothers & Co., Drexel Building, Phila., Pa.	7
Woltmann, Keith & Co., 11 Wall St., N. Y.	2
Wood & Co., R. D., Phila, Pa.	18
Woolman, G. S., 116 Fulton St., N. Y.	14
Wootton, E. H., 35 B'way St., N. Y.	11
Worthington, Henry R., N. Y. City	32
Wright & Wood, Knoxville, Tenn.	11
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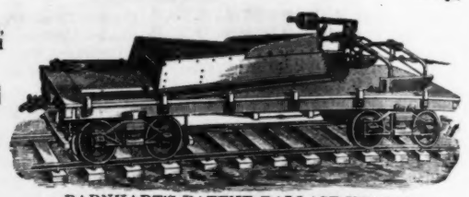

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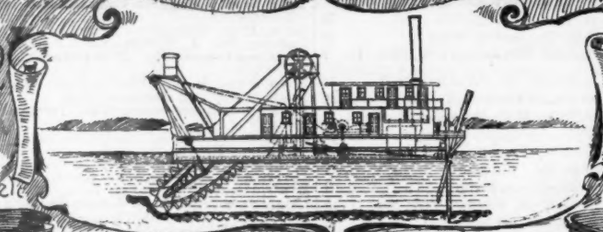

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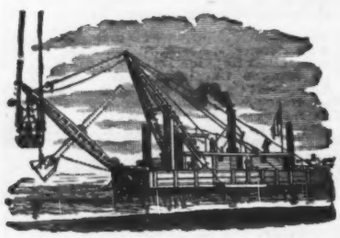

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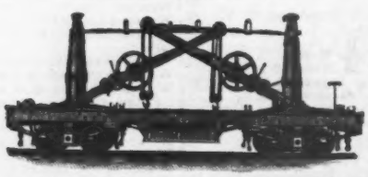

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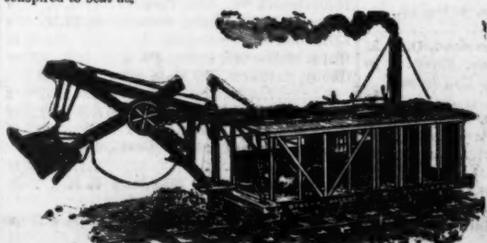

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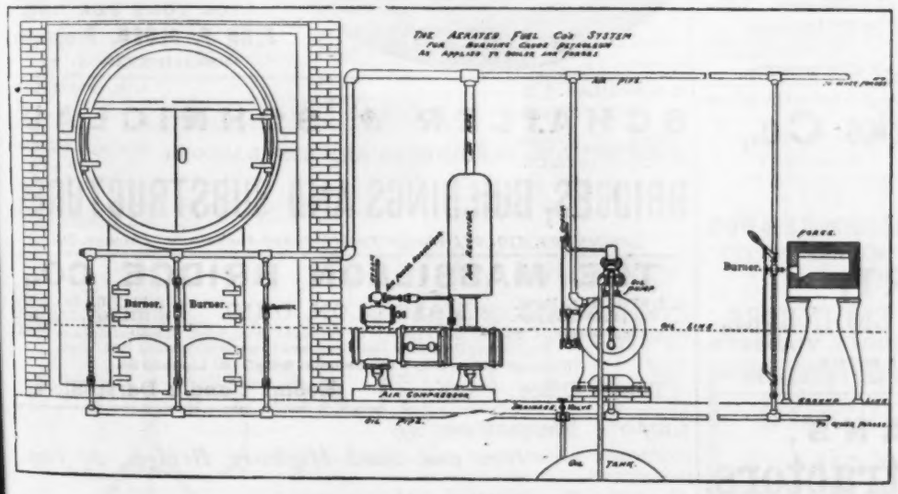

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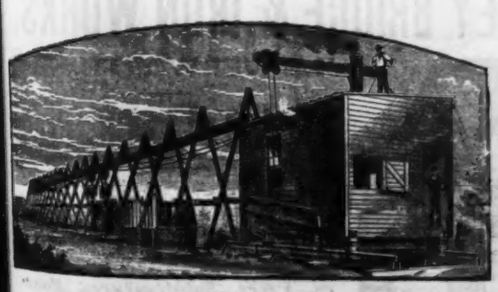

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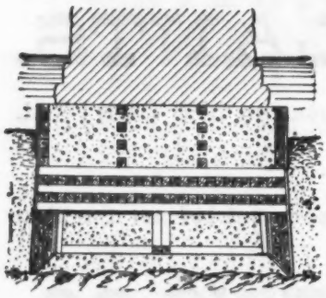

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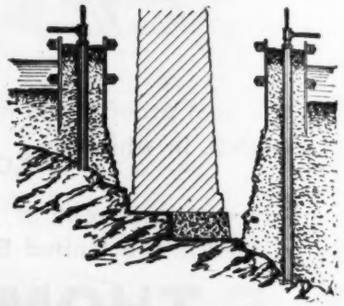

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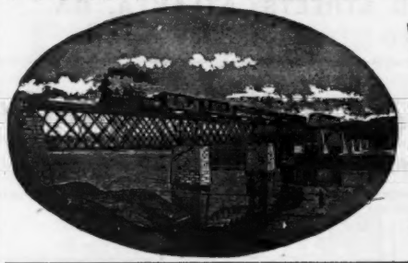

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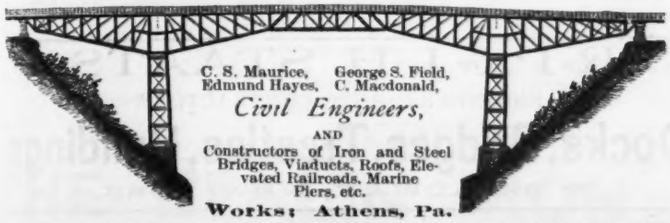

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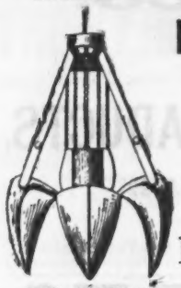

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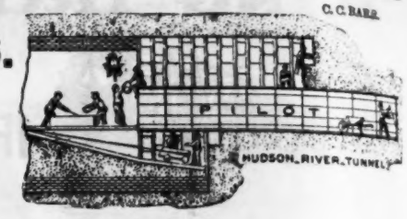

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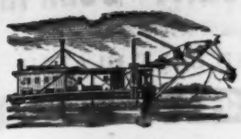

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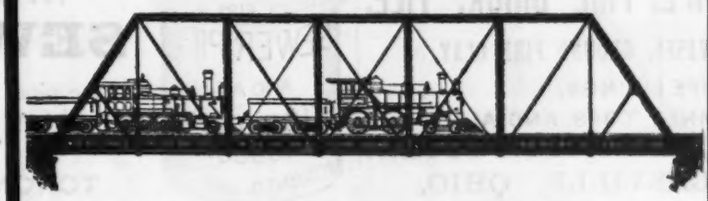

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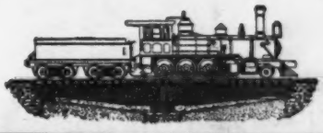

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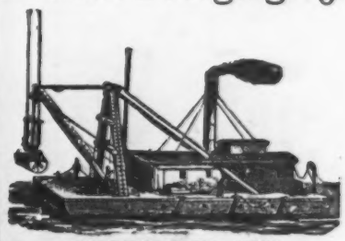

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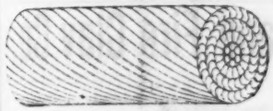

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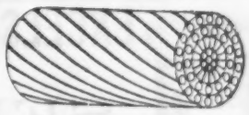

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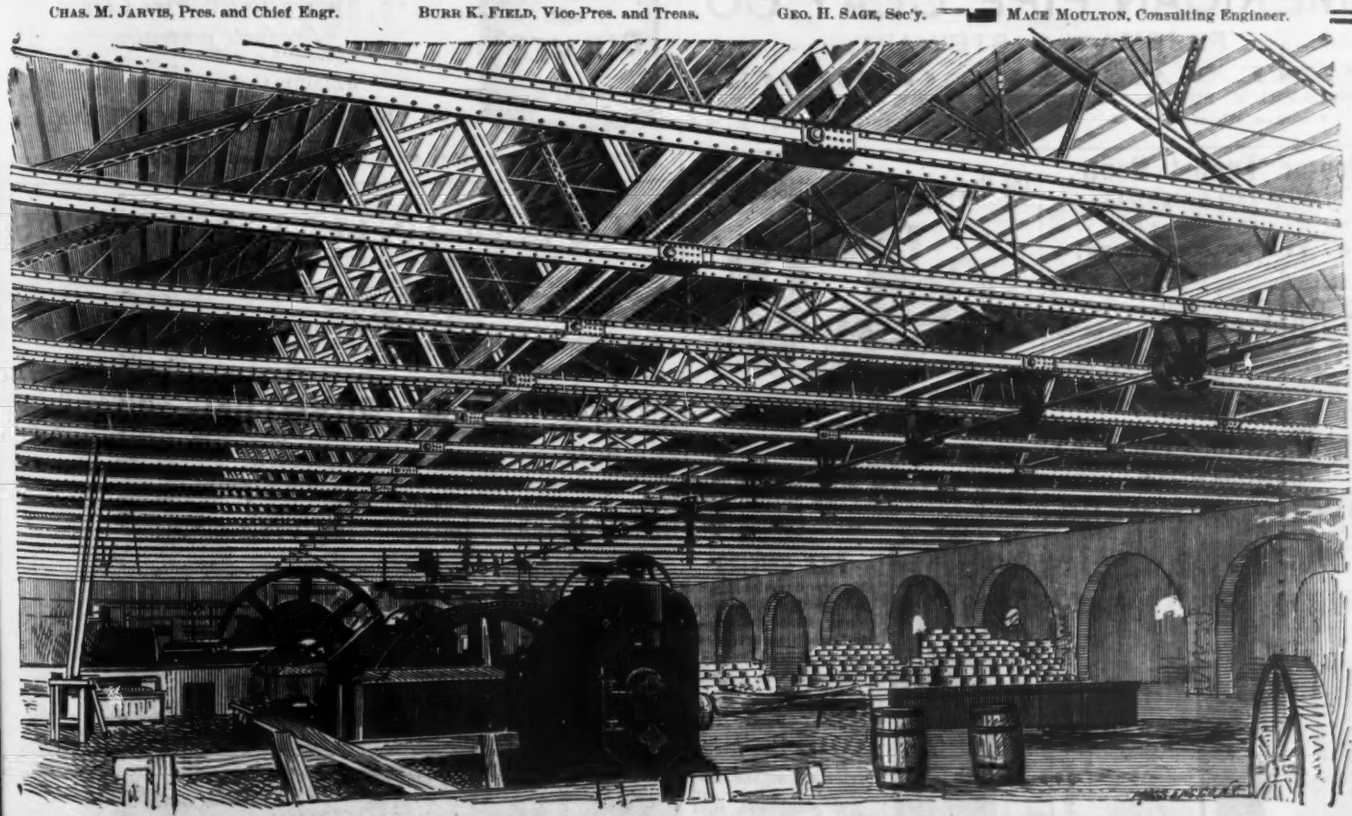

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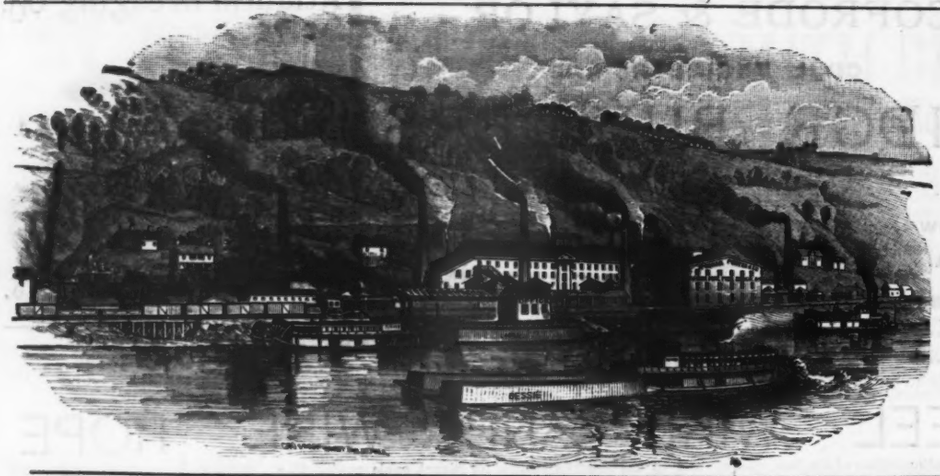

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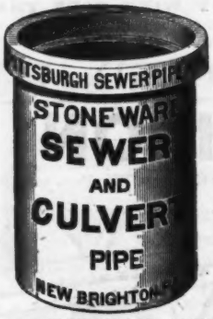

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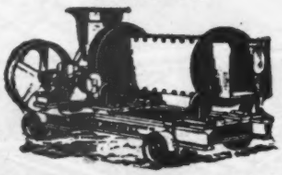

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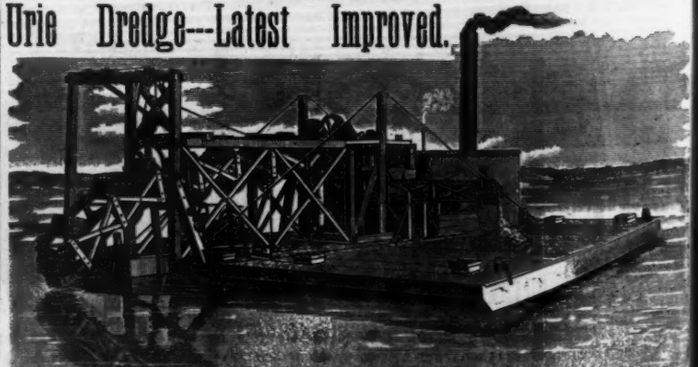

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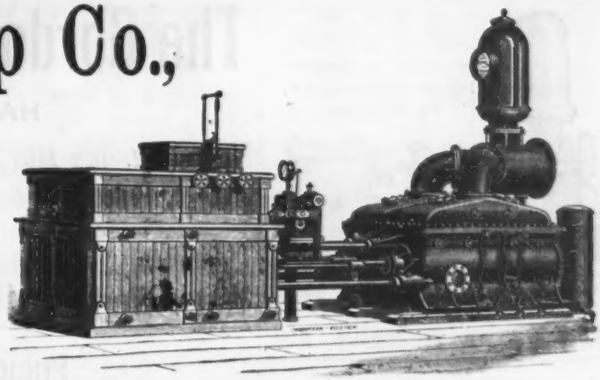

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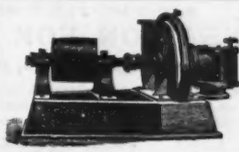

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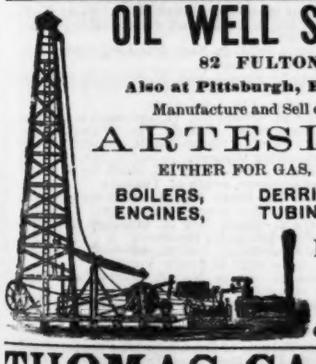

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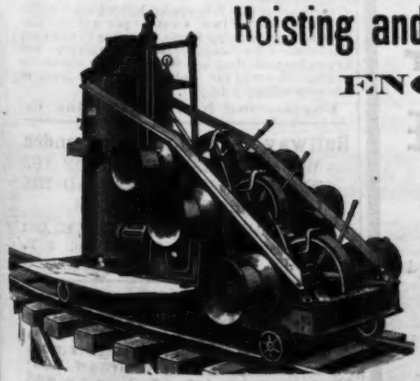

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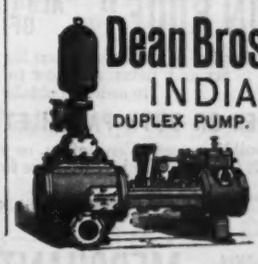

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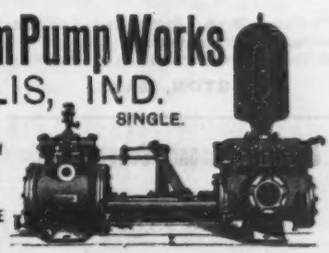

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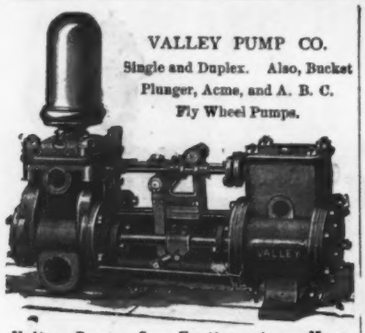

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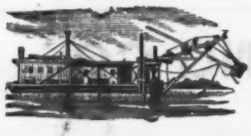

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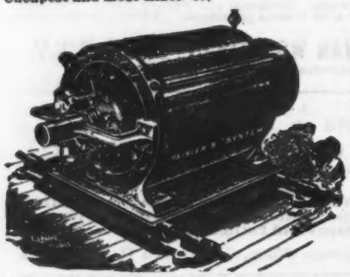

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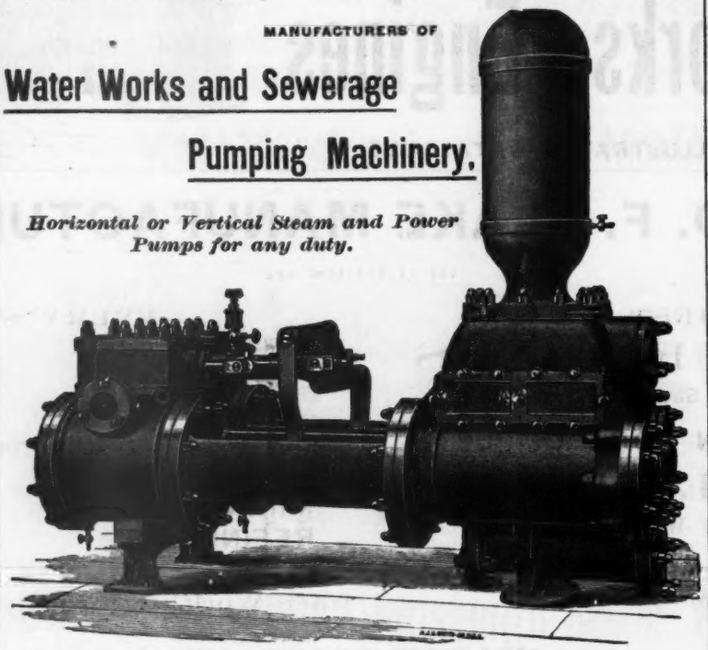

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From Croton Dam to Harlem River.

Plates 1 and 2.—Map and profile showing the route of the new Croton Aqueduct, location of shafts, blow-off and waste weirs, also route of the present aqueduct.
Plate 3.—Sheet No. 11, general form of aqueduct at north side of Harlem River. Sheet No. 3½ shows beginning of aqueduct at Croton River.
Plate 4.—Sheets No. 4, 4½ and 16 show tunnel excavation and masonry in various kinds of material.
Plate 5.—Sheet No. 5, Figs. 1 and 2, also sheet No. 6, show aqueduct under pressure in rock tunnel. Sheet No. 6½ shows aqueduct where it is in rock tunnel.
Plate 6.—Sheets Nos. 7 and 7½, general form of aqueduct in rock tunnel.
Plate 7.—Sheets Nos. 8, 8½ and 8½, aqueduct without masonry, except floor. Sheet No. 25, aqueduct in earth and rock, water pressure overhead.
Plate 8.—Sheets Nos. 9 and 9½, tunnel excavation and masonry.
Plate 9.—Sheets Nos. 17, 18 and 20, aqueduct in rock tunnel. Sheets No. 19, Fig. 1, aqueduct on flooring. Fig. 2, on piles.
Plate 10.—Sheet No. 21, aqueduct in compact and loose rock. Sheets Nos. 22 and 23, aqueduct in earth. Sheet No. 24, aqueduct in tunnel requiring support.
Plate 11. Sheet No. 13, shaft for aqueduct under pressure, south of Yonkers.
Plate 12.—Sheet No. 14, shaft for aqueduct under pressure, south of Yonkers.
Plate 13.—Sheet No. 15, masonry for shafts, aqueduct not under pressure.
Plate 14.—Sheet No. 31, blow-off and waste weir, to be built at South Yonkers.
Plate 15.—Sheet No. 28, blow-off and waste weir at Ashford on Saw Mill River.
Plate 16.—Sheet No. 26, blow-off and waste weir at Pocantico River.
Also, table of bids and prices.

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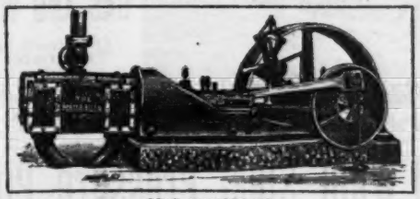

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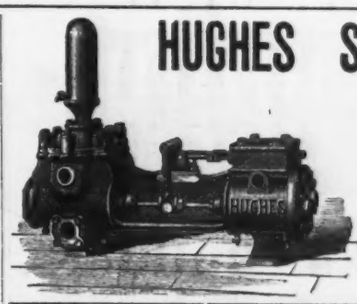

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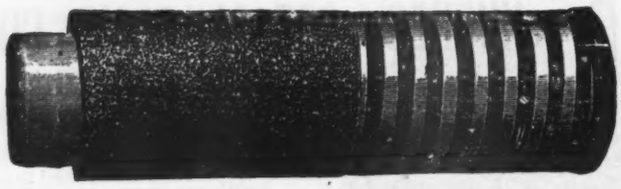

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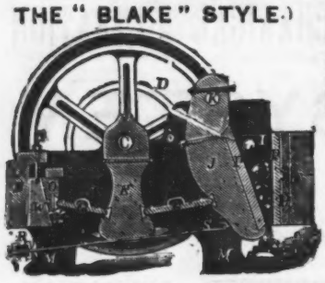

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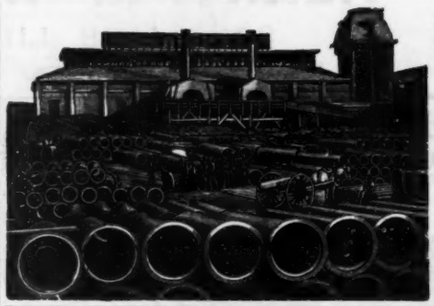

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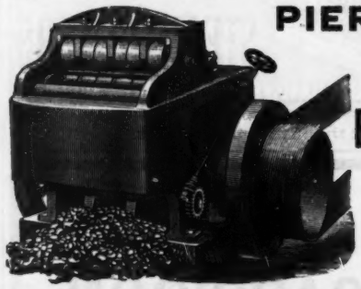

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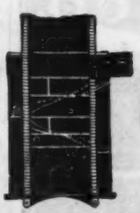

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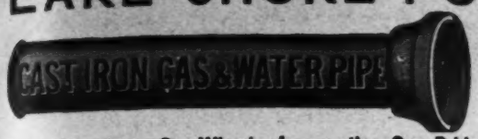

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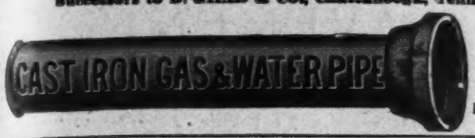

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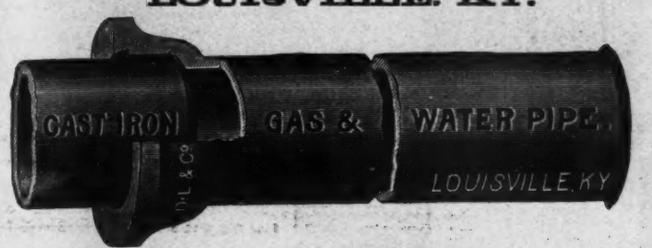

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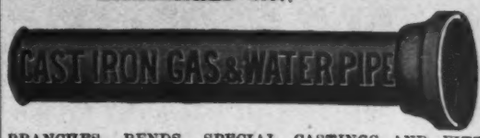

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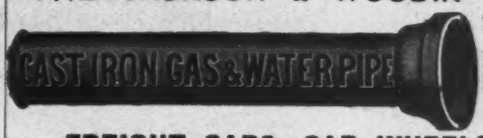

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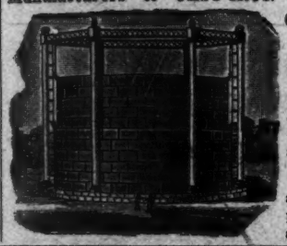

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New York	67,099	Boston	45,226
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Omaha	225,160	Scranton	84,672
Topeka	194,268	Wilkesbarre	67,464
New Orleans	151,147	Harrisburg	42,303
St. Joseph	133,363	Other cities	537,499
St. Louis	86,251		
Louisville	100,069	Total	3,916,574

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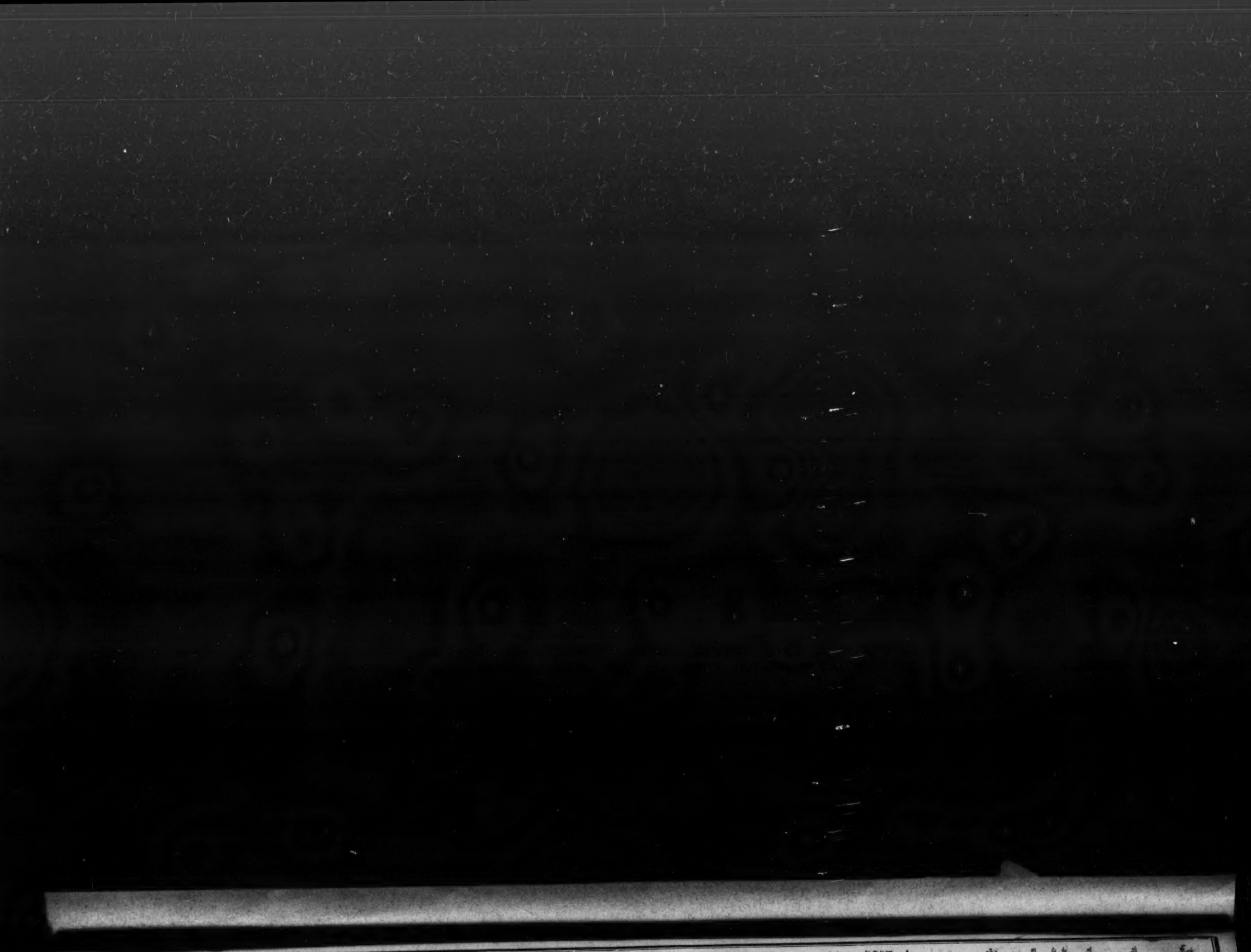
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